

***Remedial Investigation/Feasibility Study
Phase I Technical Memorandum***

***Waukegan Manufactured Gas
and Coke Plant Site
Waukegan, Illinois***

***Prepared for
North Shore Gas Company***

***Under the Administrative Order on Consent Re: Remedial Investigation and
Feasibility Study for the Waukegan Manufactured Gas and Coke Plant Site
Waukegan, Illinois***

July 1993

Barr
Engineering Company

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***July 19, 1993 Response to Comments on the
April 1993 RI/FS Phase I Technical Memorandum***

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July 19, 1993

Mr. William Bolen
U.S. Environmental Protection Agency
Region V
Waste Management Division
IL/IN Remedial Response Branch HSRL-6J
77 West Jackson Boulevard
Chicago, IL 60604

Re: Waukegan Manufactured Gas and Coke Plant (WCP) Site
Response to Comments on the April 1993 Phase I Technical Memorandum

Dear Mr. Bolen:

This response to the U.S. Environmental Protection Agency (U.S. EPA) and Illinois Environmental Protection Agency (IEPA) comments on the April 1993 RI/FS Phase I Technical Memorandum for the Waukegan Manufactured Gas and Coke Plant Site in Waukegan, Illinois, is a revised edition of my June 30, 1993 response letter. The revisions in this edition have been made in conformance with your approval letter dated July 14, 1993 and our telephone conversations of July 15 and 16, 1993.

This letter is submitted on behalf of Mr. Patrick Doyle of North Shore Gas Company and responds to your letter of May 21, 1993, which transmitted U.S. EPA and IEPA comments on the April 1993 RI/FS Phase I Technical Memorandum. This letter is the complete response to the comments in your letter of May 21, 1993, and is considered to amend and modify the April 1993 Phase I Technical Memorandum.

In addition to addressing specific comments, this letter proposes modifications to some elements of the Phase II work plan. The modifications consist of updating the Site Health and Safety Plan so that it addresses new Phase II tasks and reflects the current knowledge of the site; ensuring the success of the pumping test by building more flexibility into the pumping test design in the event that actual site conditions are not as expected; modifying the locations and construction of the piezometers to optimize information collection during the pumping test and to benefit from existing piezometers on Outboard Marine Corporation (OMC) property; modifying the standard operating procedure for field soil pH; correcting the parameter list for groundwater samples; and correcting the project schedule to resolve conflicts.

RESPONSE TO U.S. EPA COMMENTS

Comment 1: We understand this comment is related to the water level information available for wells near the OMC Plant No. 2 facility north of the WCP site. The water level data, well construction information, and boring logs shown in the Warzyn reports supplied to us by the U.S. EPA (Subsurface Investigation, North Ditch Area [C-9177] and Hydrogeologic Investigation [C-8342]) and the JRB report (Technical and Witnessing Case Support, Hydrogeology Study of Groundwater - Final Report, 1981) will be further reviewed and evaluated prior to drafting the Remedial Investigation Report. This information has been used to select water level monitoring points for the Phase II investigation program to select water level monitoring points. Changes made to the investigation program are detailed below under "Piezometer Location and Construction."

Comment 2: This comment refers to a misstatement in the Phase I Technical Memorandum. The second sentence in the fifth paragraph of Section 2.4.2.2, Hydrogeologic Model Development, will be changed to read as follows: This pattern of flow differs from that inferred from the water table elevation contour interpretations shown on Figures 2.2-5 through 2.2-8, which indicate flow toward the southwest from the northeast corner of the site.

Comment 3: The three references cited in Table 2.4-6 were chosen from the list of references in Attachment 1 because they reported naturally occurring concentration ranges for the greatest number of inorganic compounds in soils and because they summarized much of the data reported by other authors. Other references considered, but not selected, included mineral exploration guides or agricultural studies that reported concentrations for only certain elements of interest, references that reported only an average concentration instead of a range of values, references that reported values for specific geographic areas unrelated to the site, and references that were summarized in other references. We would appreciate any additional information the U.S. EPA may have on other references that should be considered.

In Section 2.4.4.2, Other Compounds, the following will be added following the first sentence in the second paragraph: The concentration ranges were selected from widely recognized references which incorporate data from a number of studies and provide a relatively comprehensive list of compounds.

Comment 4: In the discussion of the horizontal distribution of phenol in Section 2.4.5.1, Distribution of MGP/Coking and Creosote Compounds, the last sentence will be changed to read as follows: The source of phenol in the sample from Well MW-3D is unknown at this time and will be investigated during Phase II sampling.

- Comment 5: In the discussion of the horizontal distribution of arsenic in Section 2.4.5.1, Distribution of MGP/Coking and Creosote Compounds, the following sentence will be added to the end of the paragraph: The potential source of arsenic in samples from Wells MW-5D and MW-6D will be investigated during Phase II sampling.
- Comment 6: The last sentence before the semicolon in the first paragraph of Section 2.4.5.3, Identification of Phase II Analytical Parameters for Groundwater, will be changed to read as follows: The second round of Phase II groundwater samples, to be collected from all the Phase I and Phase II monitoring wells, will be analyzed for the chemical parameters listed below: ...
- Comment 7: The words "at the" will be deleted from the first sentence of the first paragraph in Section 2.4.6, Ecological Survey.
- Comment 8: The second to last sentence of the third paragraph of Section 3.3.1, Monitoring and Pumping Well Installation, will be changed to read as follows: If shallow soils in the immediate vicinity of the MW-9 well nest are contaminated with oil or tar, the MW-9 well nest will be deleted from the investigation program.
- The last sentence of the third paragraph of Section 3.3.1, Monitoring and Pumping Well Installation, will be deleted. Sampling of oil or dense nonaqueous-phase liquids (DNAPL) from wells is discussed in Item 10 of the IEPA comment responses presented below.
- Comment 9: After the first sentence in the second paragraph of Section 3.3.4, Permeability Testing, the following sentence will be added: The proposed locations for the collection of these three samples are shown on Figure 3.2-1.
- Comment 10: The first sentence of the fourth paragraph in Section 3.3.4, Permeability Testing, will be changed to read as follows: The water pumped from Well PW-1 during the pumping test will be pumped into a storage tank on site and stored in the tank for the entire duration of the pumping test.
- Comment 11: The last two sentences of the eighth bullet under Section 3.5.1, General Remediation Evaluation Parameters, will be replaced with the following sentence: TCLP samples will be placed in a stainless steel bowl, objects larger than 1/2 inch in size will be removed, and the samples will be promptly packaged in laboratory containers.
- Comment 12: Revised Tables 3.6-1 and 3.6-2 are in Attachment 2. The tables have been revised to include the following: risk assessment and concurrent ecological assessment duration of ten weeks; risk assessment and ecological assessment to begin after U.S. EPA

approval of the Preliminary Characterization Summary; and agency review periods of 30 days for all comments or approvals. Exceedence of the schedules for U.S. EPA activities will result in equal extensions of the total project time. The critical links are illustrated on enclosed Table 3.6.2. The schedule has been corrected to resolve schedule conflicts, as described below under "Schedule."

It is understood that PRC Environmental Management, Inc. (the U.S. EPA oversight contractor) will be conducting the ecological assessment.

Comment 13: In Table 2.4-7, the results for methylene chloride and carbon disulfide for the background soil samples were inadvertently switched. The table will be corrected to read as follows:

FREQUENCY OF DETECTION (Maximum Concentration in $\mu\text{g/kg}$)	
Parameter	BS
Methylene chloride	ND
Carbon disulfide	3/9 (4)

This correction does not affect the text in Sections 2.4.3, Background Soil Quality Summary, and 2.4.4.4, Identification of Phase II Analytical Parameters for Soil.

Comment 14: General water quality parameters will be analyzed in order to assess potential treatability alternatives. In the August 1992 Phase I Technical Memorandum, a short list of parameters (BOD/COD, oil and grease, total suspended solids) for assessing treatability alternatives was to be run on the second round of groundwater samples from all the wells. The April 1993 Phase I Technical Memorandum moved the sampling up to the first sampling event and expanded the parameter list to include sulfate, sulfide, chloride, acidity, alkalinity, total hardness, total dissolved solids, and total organic carbon. The wells for which this longer list of parameters will be analyzed were selected to be representative of the various areas around the site: MW-9S and MW-9D for the gas plant/coke plant process area; MW-7S and MW-7D for the northeast pond area; MW-12S and MW-12D for the area east of the plant process area; MW-10S and MW-10D for the area south and southwest of the process area; and MW-6S and MW-6D for the former creosote plant area. This program is designed to give broad aerial coverage of the investigation area and provides an opportunity to review the data prior to the second round of sampling.

Comment 15: Appendix I does not state that the base of the sand aquifer is horizontal. Appendix I states that a horizontal base was assumed for the purposes of groundwater flow modeling. This assumption is appropriate for the groundwater flow modeling for two reasons. First, the slope of the top of the till surface is reasonably flat, sloping at approximately 0.5 percent from Monitoring Well MW-6D to MW-4D. Second, the effect of that slope on the transmissivity of the aquifer (transmissivity is used by the model in its calculations) is small compared to the effect of other factors, such as hydraulic conductivity. Hydraulic conductivity estimates are only order of magnitude estimates. For example, a change in saturated aquifer thickness from 22 to 28 feet at a constant hydraulic conductivity of 6 feet per day would result in a change in transmissivity from 130 to 170 feet squared per day. This change in transmissivity (an increase by less than a factor of 1.5) is far less than the order of magnitude uncertainty in the estimate of hydraulic conductivity. Consequently, it would not be justifiable to refine the model to account for the slight slope of the till surface, given the level of other uncertainties inherent in the preliminary modeling.

Appendix I states that all simplifying assumptions about the hydrogeologic conditions of the site that were made during development of the groundwater flow model would be reevaluated with the additional hydrogeologic data to be collected during the Phase II investigation. If the Phase II data confirms a slope on the base of the aquifer and if modeling that slope will improve the quality of the modeled results and conclusions that can be drawn from the modeling, the slope will be modeled.

Comment 16: The comment states that the model used hydraulic conductivity values of 6 feet per day (2.1×10^{-3} cm/s) on-site and 20 feet per day (7.1×10^{-3} cm/s) off-site. However, the groundwater modeling used a 6-foot per day hydraulic conductivity value not only for on-site areas, but also for all off-site areas for which model results were used to help preliminary assessments of groundwater flow. Thus, a uniform hydraulic conductivity was used for the entire peninsula where the site is located, as well as for the OMC Plant No. 2 property as far north as the North Ditch.

The hydraulic conductivity value of 6 feet per day was the geometric mean of all the available hydraulic conductivity values for the modeled area of interest. The hydraulic conductivity, the defined boundary conditions, and the infiltration are the parameters that controlled the groundwater flow solution produced by the model for the area of interest.

There was no attempt in the Phase I preliminary modeling to accurately model groundwater flow patterns in areas that do not affect the solution in the area of interest, i.e., the vicinity

of the site and OMC Plant No. 2. This is consistent with the stated objectives of the Phase I preliminary modeling, which were to provide an initial evaluation of steady-state groundwater flow patterns, to provide guidance in locating new monitoring wells, to identify data gaps, and to design the Phase II pumping test. The 20-foot per day hydraulic conductivity outside the area of interest was an arbitrary assumption that was not adjusted during final calibration of the preliminary model, in the knowledge that this assumption would not affect the solution at the site. These matters are all briefly reviewed, in a level of detail appropriate to the preliminary modeling effort and its purposes, in Appendix I, especially paragraphs 1 and 6.

Comment 17: The sixth paragraph in Section 2.4.2.2, Hydrogeologic Model Development, much of Section 3.3.5, Hydrogeologic Model Development, and the seventeenth paragraph in Appendix I all address this comment.

Comment 18: A laboratory standard operating procedure for cation exchange capacity is in Attachment 3.

Comment 19: A laboratory standard operating procedure for weak acid dissociable cyanide is in Attachment 3.

RESPONSE TO IEPA COMMENTS

1. Disposal of Groundwater Produced During Well Development, Sampling, and Pumping Test.

The IEPA has stated that this water may potentially be a pollution control waste, regulated under special waste regulations in 35 Illinois Administrative Code Subtitle G, Section 809. If this characterization of the water is correct, the water could not be discharged except to a publicly owned treatment works (POTW) or under the terms of an NPDES or other discharge permit. Without agreeing or disagreeing with the IEPA comment, Barr Engineering Company has contacted the North Shore Sanitary District (NSSD) and obtained their concurrence that, in principle, site water can be pretreated and discharged to their system. Barr is attempting to obtain permits from the IEPA and NSSD for discharge of these waters to the NSSD. The Phase II field work cannot begin until the necessary permits have been obtained.

We anticipate that the same pretreatment program envisioned for discharge to the NSSD would satisfy the requirements to spray-irrigate the water on-site. Management of the water on-site by spray irrigation would not require a formal permit under Superfund. We believe the substantive requirements for on-site management of the water have been addressed with the plan to treat the water with activated carbon and electro-chemical precipitation as described in the Phase I Technical Memorandum.

During the Phase I work, the discharge of well development and well purging water, as well as the management of other investigation-derived wastes, was performed pursuant to the Work Plan approved by the IEPA and U.S. EPA on November 15, 1991. The management of these materials was consistent with the U.S. EPA "Guide to Management of Investigation-Derived Wastes."

2. Fire Training and Storage of Petroleum and PCBs On-Site by OMC.

More thorough information regarding these matters will be sought from OMC for inclusion with the Remedial Investigation Report.

3. Analytical Parameter Reporting.

During the conference call on June 7, 1993, William Bolen of the U.S. EPA, Tracy Fitzgerald and Jerry Willman of the IEPA, and James Langseth of Barr Engineering Company agreed that the proposed parameter list in Table 2.4-8 would be satisfactory.

4. Drilling in Highly Contaminated Areas.

a. Borings.

At the request of the IEPA, borings will be grouted with bentonite slurry, rather than neat cement grout. The slurry will be tremied into the borehole.

If we have information on the relative merits of these two approaches, we will provide it to the IEPA and the U.S. EPA.

b. Wells.

The only well location considered likely to encounter oil or tar is the MW9S/MW9D pair. As stated on page 71 of the Phase I Technical Memorandum: "If soils in the immediate vicinity of the MW9 well nest are contaminated with oil or tar that appears likely to flow into the well, the MW9 well nest will be deleted from the investigation program." We agreed that this would be a satisfactory program for handling this contingency.

5. Soil Cuttings and Purge Water from Off-Site Installations.

It was agreed that purge water would be transported back to the site and managed as described above (item 1) for all purge water and well development water. All off-site soil cuttings will be brought back to the site and managed as described in item 6 below.

6. Soil Cuttings On-Site.

Soil cuttings which are visibly clean and do not register readings on hand-held air quality screening devices when monitored within 3 inches of the surface of the soil will be left on the ground on-site within the fenced area. Off-site soil cuttings brought back to the site that meet these criteria will also be placed on-site adjacent to other soil cuttings. Soil cuttings not meeting these criteria will be placed in drums for future management.

7. Surface Samples for Volatile Organic Compound Analysis.

We agreed that VOC analysis of the 0 to 6-inch surface soil samples is for the purpose of risk assessment and, therefore, would be performed as provided in the Phase I Technical Memorandum. VOC information has already been obtained from the seventeen shallow soil samples (2 to 4-foot depth) collected during the Phase I investigation.

8. Identification of the Soil Stockpile Referred to in Section 3.2.3.1.

The identification of the soil stockpiles is adequately presented in Section 3.2.3.1, Soil Stockpile Soil Samples, and Section 3.2.3.2, Designated Soil Stockpile Characterization.

9. Wells in Areas with Free-Flowing Contaminants.

This issue was addressed under item 4 above.

10. Sampling Oil or DNAPL from Wells.

Prior to purging a well, a probe will be inserted to the full depth of the well and observed for the presence of DNAPL. In the event DNAPL is discovered, an effort will be made to sample the DNAPL if there is sufficient depth of product to make sampling physically feasible. It should be recognized that the water quality data from wells containing DNAPL is likely to be inconsistent over time and not representative of the concentrations of dissolved phase contaminants that might be transported with groundwater.

Additional guidance on DNAPL investigation is provided in Attachment 4.

11. Groundwater Discharge at the Site.

This issue was addressed under item 1 above.

12. PCB Analysis as Referenced under Section 2.4.4.4(1).

As agreed at the March 5, 1993 meeting, samples from new monitoring wells MW11S and MW11D will be analyzed for PCBs (as are all first round samples from the site monitoring wells). Analysis of soil samples for PCBs will be performed on samples from the existing sand stockpile and designated soil stockpile as provided in the Phase I Technical Memorandum.

OTHER MODIFICATIONS TO THE PHASE II WORK PLAN

Site Health and Safety Plan

Amendments to the October 1991 Site Health and Safety Plan are in Attachment 5. The first amendment updates the project tasks, the work zones, the personal protective equipment, the potential chemical hazards on-site, the air monitoring procedures, and the water safety procedures for the Phase II investigation. The second amendment updates changes in project personnel.

The appendices to the safety plan have also been updated. However, a copy of the appendices is not enclosed because the appendices are not project specific. The appendices constitute a standard Barr document that summarizes Barr standard operating procedures and Barr safety policies for all Barr projects. The appendices will be available on-site during the Phase II field work.

Pumping Test Design

The current pumping test design consists of pumping a 4-inch diameter pumping well at a rate of 15 gallons per minute for 24 hours and observing drawdown continuously in Monitoring Wells MW-1S and MW-1D and Piezometers P-104 and P-106 and at discrete time intervals in Monitoring Wells MW-6S, MW-6D, MW-9S, and MW-9D and Piezometer P-103. This design was based on hydraulic conductivity estimates obtained from the slug tests. If the hydraulic conductivity of the sand aquifer is actually an order of magnitude greater than estimated by the slug tests, meaningful drawdown may not be obtained from the observation wells at a pumping rate of 15 gallons per minute. In order to ensure the success of the pumping test in the event that actual site conditions are not as expected, the pumping test design is being modified to allow for greater pumping rates and more flexibility in the field. The following modifications will address this matter:

1. Increase the diameter of the pumping well from 4 inches to 6 inches in order to allow submersible pumps of a greater capacity to be lowered into the well.
2. Determine the actual pumping rate by means of a step drawdown test at the pumping well after installation of the well.

Should the groundwater removed from the pumping well during the pumping test have to be stored and treated on-site and then discharged to the sanitary sewer, it may be necessary to reduce the duration of the pumping test from 24 hours to 12 or 8 hours, if the actual pumping rate increases by a factor of 2 or 3. Because the drawdown data obtained from the observation wells will only be used to estimate hydraulic conductivity and not the storage coefficient, the duration of the pumping test is not as important as stressing the aquifer adequately.

There is some uncertainty as to whether boundary effects of the slip wall will be observed in the water level data from Monitoring Wells MW-1S and MW-1D.

Therefore, Piezometer P-106 will be installed approximately 20 feet south of the pumping well instead of east of the pumping well. The symmetry of the response curves for Monitoring Wells MW-1S/MW-1D and Piezometer P-106 can then be compared in order to determine whether boundary effects of the slip wall have been observed. An additional piezometer, Piezometer P-107, will be installed north of the pumping well as close as possible to the slip wall. Piezometer P-107 will be in line with Wells MW-1S and MW-1D, Piezometer P-106, and the pumping well. The construction of Piezometer P-107 will be identical to that of P-106, and water levels in Piezometer P-107 will be monitored continuously during the pumping test. Boundary effects of the slip wall may or may not be observed in the water level data obtained from Piezometer P-107 during the pumping test, depending on the duration and flow rate of the test. However, water level measurements from this piezometer will be examined (along with water level data from the Harbor and Wells MW-6S and MW-5S) to estimate relative resistance values for the slip and harbor walls.

Piezometer Locations and Construction

Piezometers P-105 will not be installed as proposed. Information obtained from the OMC Plant No. 2 PCB investigation indicates that OMC currently has two piezometers (Z-1 and Z-2) located in the vicinity of proposed Piezometer P-105. The locations of these piezometers are shown on the figure in Attachment 6. These two piezometers will be monitored during the Phase II program in place of P-105. Construction logs for these piezometers will be included in the Remedial Investigation Report.

Piezometers P-106 and P-107 will be constructed of 2-inch diameter PVC instead of 1-inch diameter PVC as stated in the Phase II work plan. A larger diameter will ensure that the transducer (the probe that will be used during the pumping test to record water levels) can be lowered into the piezometers without problems. A larger diameter will also allow a water level marker to be lowered into the piezometers while the transducer is in place.

Phase II Groundwater Quality Parameters

Amenable cyanide was inadvertently left off of the list of Phase II groundwater quality parameters in the Phase II work plan. All groundwater samples obtained from the monitoring wells during the second monitoring event and all groundwater samples obtained from the HydroPunch tool during installation of the soil borings will be analyzed for amenable cyanide in addition to the other Phase II parameters. The Phase II analytical parameters for groundwater samples are listed in the table in Attachment 7.

In the Phase II work plan, it was stated that the groundwater samples would be analyzed for the volatile organic compounds in EPA Method 8240. This list of parameters is slightly different than the Contract Laboratory Protocol Target Compound List (CLP TCL) of volatile organic compounds analyzed during the Phase I investigation. The parameters trichlorofluoromethane, vinyl acetate, 2-chloroethylvinylether, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2-dichlorobenzene are on the Method 8240 list, but not on the CLP TCL. It was our intention to keep the volatile organic parameter list consistent during both phases of the remedial investigation. For this reason, the groundwater samples

from the Phase II investigation will be analyzed for the CLP TCL volatile organic compounds instead of the Method 8240 compounds. The Phase II analytical parameters for groundwater samples are listed in the table in Attachment 7.

Surface Water Sampling

The same changes to the list of analytical parameters that were made to the groundwater sampling program will be made to the surface water sampling program. The changes were described in the preceding section.

Field Soil pH

The use of a pH meter instead of litmus paper is proposed for the measurement of soil pH in the field. According to ASTM D4972-89 Standard Test Method for pH of Soils, the pH meter calibrated with buffer solutions is more accurate than the litmus paper. The revised Attachment 4a Standard Operating Procedure for the Field Measurement of Soil pH is in Attachment 8.

Schedule

The schedule for the RI/FS work is shown in Table 3.6-1. An illustration of the schedule for the remaining work is in Table 3.6-2. The revised schedule for the RI/FS work provides 30-day periods for U.S. EPA review of all deliverables, and provides ten weeks following approval of the Preliminary Characterization Summary for completion of the draft risk assessment and ecological assessment.

The revised schedule also resolves task start/finish conflicts that were introduced by the extension of the risk assessment schedule. The start date of the risk assessment/ecological assessment was revised to follow the approval of the Preliminary Characterization Summary. The start date for the Screened Alternatives and Proposed ARARs Technical Memorandum was revised to follow the final revisions to the risk assessment/ecological assessment and the approval of the Remedial Investigation Report. These start/finish dependencies are indicated on Figure 3.6-2 by vertical arrows. An additional benefit of these schedule revisions is the elimination of the concurrent review of the draft Remedial Investigation report and the Technologies and Screening Process Technical Memorandum by the U.S. EPA and IEPA. Start/finish relationships for other sequential tasks, such as receiving U.S. EPA review and comment on the Alternatives Array Summary prior to beginning the Comparative Analysis of Alternatives, are not shown with vertical arrows. The technical memoranda in the Remedial Alternatives Development and Screening task and in the Alternatives Evaluation task are naturally sequential. Each technical memorandum is dependent on the comment and guidance provided from the U.S. EPA review of the previous technical memorandum. Because of the explicit and natural time dependencies in the schedule, extension of scheduled U.S. EPA review time and/or completion of the risk assessment/ecological assessment will result in commensurate extension of the remaining tasks in the schedule.

This letter constitutes the final addenda to the April 1993 Phase I Technical Memorandum. The Phase I Technical Memorandum will not be resubmitted.

Please contact me with any questions regarding this letter.

Sincerely,



James R. Langseth

KAF:crs

Enclosures

c: Jerry Willman
Patrick Doyle
Jerry Picha
Rick Hersemann
Margaret Skinner
Marianne Grammer
Steve Armstrong
Dan Bicknell
Jerry Maynard
James Campbell
Russell Selman

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Attachments

Attachment 1

Soil Chemistry References

ATTACHMENT 1
SOIL CHEMISTRY REFERENCES

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Attachment 2

Revised Project Schedule

ATTACHMENT 2

TABLE 3.6-1

ESTIMATED DURATION OF PROJECT TASKS
REVISION 3

ACTIVITY	START	TASKS	START DATE	TASK DURATION (WEEKS)	CUMULATIVE DURATION ^{1,2} (WEEK NUMBER)	COMPLETION DATE
Phase I Field Investigation	Work Plan Approved and Site Access Obtained	Investigation Support	2/26/92 ²	8	8	4/23/92
		Test Trenching	3/9/92	6	7	4/17/92
		Surficial Soil/Background Sampling	3/2/92	4	4	3/28/92
		Monitoring Wells/Soil Borings	3/9/92	6	7	4/17/92
		Groundwater Sampling/Slug Tests	4/6/92	1	6	4/10/92
		Ecological Survey	5/27/92	5	18	6/30/92
		Sample Analysis/Validation	3/92	18	22	7/92
		Data Evaluation/Modeling	3/92	18	22	7/92
		Phase I Tech Memo	5/28/92	13	26	8/28/92
		Revised ARARs/PRG Tech Memo	7/16/92	5	27	9/5/92
		EPA Review	8/30/92	23	50	2/8/93
		EPA Review Meeting	3/5/93	0	53	3/5/93
		Phase I Tech Memo Revisions	3/6/93	4	59	4/13/93
		EPA Review	4/14/93	4	64	5/21/93
		Phase I Tech Memo Revisions	5/21/93	5	69	6/30/93
		EPA Review and Approval	7/1/93	4	72	7/19/93
Phase II Field Investigation	Phase I Tech Memo Approved	Investigation Support	9/30/92	58	88	11/5/93
		Monitoring Wells	8/16/93	4	80	9/10/93
		Soil Borings	9/13/93	5	85	10/15/93
		Groundwater Sampling #1	9/20/93	1	82	9/24/93
		Sample Analysis/Validation #1	8/16/93	11	87	10/29/93
		Pumping Test	10/18/93	2	87	10/29/93
		Groundwater Sampling #2	11/1/93	1	88	11/5/93
		Sample Analysis/Validation #2	11/1/93	8	95	12/24/93
		Data Evaluation	8/16/93	24	100	1/28/94
	Sample Validation Complete	Preliminary Characterization Summary	12/27/94	5	100	1/28/94
		EPA Review and Approval	1/31/94	2	102	2/11/94

ATTACHMENT 2 (Cont.)

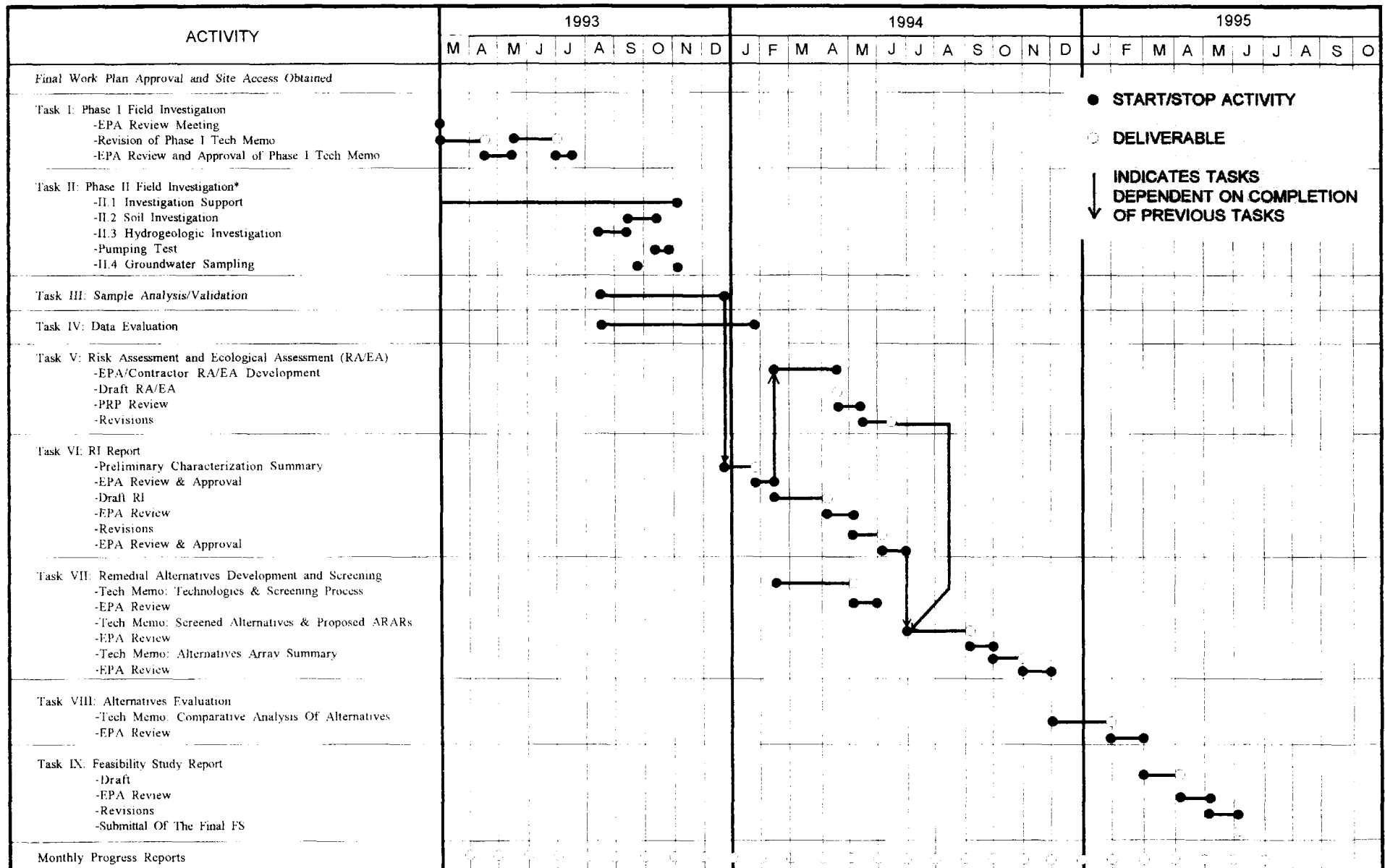
TABLE 3.6-1

ESTIMATED DURATION OF PROJECT TASKS
REVISION 3

ACTIVITY	START	TASKS	START DATE	TASK DURATION (WEEKS)	CUMULATIVE DURATION ^{1,2} (WEEK NUMBER)	COMPLETION DATE
Risk Assessment and Ecological Assessment	Preliminary Characterization Summary Approved	Risk Assessment and Ecological Assessment	2/14/94	10	112	4/22/94
RI Report, Remedial Technologies Screening, Risk Assessment Review	Preliminary Characterization Summary Approved	Prepare Draft RI Report	2/14/94	8	110	4/8/94
		Prepare Tech Memo on Technologies and Screening Process	2/14/94	12	114	5/6/94
		EPA Review of Draft RI	4/11/94	4	114	5/6/94
		PRP Review of Risk Assessment	4/25/94	4	116	5/20/94
		EPA Review of Tech Memo on Technologies and Screening Process	5/9/94	4	118	6/3/94
		Revisions to Draft RI	5/9/94	4	118	6/3/94
		EPA Risk Assessment Revisions	5/23/94	4	120	6/17/94
		EPA Review and Approval of Revised RI	6/6/94	4	122	7/1/94
Alternatives Development and Screening, Alternatives Evaluation, FS Report	EPA Risk Assessment Completed and Revised RI Approved	Prepare Tech Memo on Screened Alternatives and Proposed ARARS	7/5/94	9	131	9/2/94
		EPA Review of Tech Memo on Screened Alternatives and Proposed ARARS	9/5/94	4	135	9/30/94
		Prepare Tech Memo on Alternatives Array Summary	10/3/94	5	140	11/4/94
		EPA Review of Tech Memo on Alternatives Array Summary	11/7/94	4	144	12/2/94
		Prepare Tech Memo on Comparative Analysis of Alternatives	12/5/94	8	152	1/27/95
		EPA Review of Tech Memo on Comparative Analyses of Alternatives	1/30/95	4	156	2/24/95
		Prepare Draft FS Report	2/27/95	6	162	4/7/95
		EPA Review	4/10/95	4	166	5/5/95
		Revisions to Draft FS/ Submittal of Final FS	5/8/95	5	171	6/9/95
PROJECT TOTAL:					39 Months	

¹Accounts for concurrent tasks.²Based on full site access having been granted on February 26, 1992.

ATTACHMENT 2
TABLE 3.6-2
ESTIMATED REMAINING PROJECT SCHEDULE, REVISION 3



*Start dates for Phase II field work are contingent on regulatory approvals or appropriate permits (if any) for managing investigation-derived wastes.

Attachment 3

***Laboratory Standard Operating
Procedures for Cation Exchange Capacity
and Weak Acid Dissociable Cyanide***

SOP No.: LRD I-0069
Rev No.: 1
Date: 06/11/93

**SOIL ANALYSIS
FOR
CATION-EXCHANGE CAPACITY (SODIUM ACETATE)**

This method is confidential and is intended for the sole use and benefit of CH²M HILL, and may not be modified, reproduced, circulated or quoted in whole or in part, except with the approval of the Laboratory District Manager of CH²M HILL. CH²M HILL assumes no responsibility whatsoever for the precision and bias of results or the safety of any analysis utilizing this method unless performed by CH²M HILL. It is the responsibility of the user of this method to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use. This method may be changed by CH²M HILL at any time without notice.

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SOIL ANALYSIS FOR
CATION-EXCHANGE CAPACITY (SODIUM ACETATE)

Working Linear Range: NA
Reporting Limit: NA
Reporting Units: NA
Matrix: Soil
Holding Time: 180 days from date of collection

1.0 Scope and Application

1.1 To establish a standard practice for the sodium acetate extraction of most soils, including calcareous and noncalcareous soils for the measurement of the soils cation-exchange capacity. This method is functionally and analytically equivalent to, and meets all quality control requirements of, USEPA Method 9081, CATION-EXCHANGE CAPACITY OF SOILS (SODIUM ACETATE).

2.0 Method Summary

2.1 The soil sample is mixed with an excess of sodium acetate solution, resulting in an exchange of the added sodium cations for the matrix cations. Subsequently, the sample is washed with isopropyl alcohol. An ammonium acetate solution is then added, which replaces the adsorbed sodium with ammonium. The concentration of displaced sodium is then determined by Inductively Coupled Argon Plasma optical emission spectroscopy (ICP), or an equivalent means.

3.0 Interferences

3.1 Interferences can occur during analysis of the extract for sodium content. Thoroughly investigate the chosen analytical method for potential interferences.

4.0 Safety Precautions

4.1 Exercise normal laboratory safety precautions when performing this method.

5.0 Sample collection and Handling

5.1 Sample Collection, Preservation, and Handling:
All federal, state, local, customer, or CH2M HILL

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requirements must be met.

5.2 Sample Size: minimum 25 g.

5.3 Container: glass or plastic

5.4 Preservation: none

6.0 Apparatus

6.1 Centrifuge tube with screw top, 50 mL, plastic, disposable.

6.2 Centrifuge

6.3 Mechanical shaker

6.4 Volumetric flask, 100 mL, glass, ASTM E694 Class A.

6.5 pH Meter

7.0 Routine Preventive Maintenance

7.1 Not applicable.

8.0 Reagents and Calibration Standards

8.1 ~~Reagent Water~~: Reagent water is defined as water in which an interference is not observed at or above the method detection limit of the analyte(s) of interest. Typically dionized water, equivalent to ASTM Type IV water (ASTM D 1193) is used.

8.2 Sodium acetate, ACS reagent grade or better $\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$.

8.2.1 Sodium acetate, NaOAc, 1.0N: Dissolve 136 g of $\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$ in reagent water and dilute it to 1L. The pH of this solution should be 8.2 ± 0.1 . If needed, add a few drops of acetic acid or NaOH solution to bring the pH of the solution to 8.2 ± 0.1 .

8.3 Sodium Hydroxide, concentrated, ACS reagent grade or better NaOH.

8.3.1 Sodium Hydroxide, 0.01N: Dissolve 0.4 g

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of NaOH in 1 L of reagent water.

8.4 Ammonium Hydroxide, concentrated, ACS reagent grade or better NH_4OH .

8.5 Acetic Acid, glacial (99.5%), ACS reagent grade or better.

8.6 Ammonium Acetate, ACS reagent grade or better NH_4OAc .

8.6.1 Ammonium Acetate, NH_4OAc , 1.0N:
Dissolve 154.2 g of NH_4OAc in reagent water in a 2.0 L volumetric flask and dilute to approximately 1980 mL. Check the pH of the resulting solution, adding additional ammonium hydroxide or glacial acetic acid as needed to obtain a pH of 7.0 ± 0.1 , then dilute the solution to a volume of 2.0 L with reagent water.

8.6.2 Ammonium Acetate, NH_4OAc , 1.0N,
Alternate Preparation: Dilute 114 mL of glacial acetic acid with reagent water to a volume of approximately 1 L. Add 138 mL of concentrated ammonium hydroxide, mix, then dilute to approximately 1980 mL with reagent water. Check the pH of the resulting solution, adding additional ammonium hydroxide or glacial acetic acid as needed to obtain a pH of 7.0 ± 0.1 , then dilute the solution to a volume of 2.0 L with reagent water.

8.8 Isopropyl alcohol, ACS reagent grade or better $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$.

9.0 Calibration Procedure

9.1 The pH meter should be calibrated according to LRD SOP I-0050.

10.0 Sample Preparation

10.1 Mix the sample gently to insure a representative sample.

11.0 Sample Analysis

11.1 Weigh 5.0 g of soil into a 50 mL centrifuge tube.

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11.2 Add 33 mL of 1.0N NaOAc solution, seal the tube, and shake in the shaker for 5 minutes.

11.3 Centrifuge for 5 minutes (until solution is clear) and decant the liquid (into a 100 mL volumetric flask for extractable calcium and magnesium analysis).

Note: If for CEC only, discard this solution.

11.4 Repeat steps 11.2 and 11.3 two more times. Dilute to 100 mL with reagent water for extractable calcium and magnesium analysis.

11.5 Add 33 mL of 99% isopropyl alcohol, seal the tube and shake it for 5 minutes.

11.6 Centrifuge for 5 minutes (until solution is clear) and decant and discard the liquid.

11.7 Repeat steps 11.5 and 11.6 two more times.

11.8 Add 33 mL of NH₄OAc solution, seal the tube and shake it for 5 minutes.

11.9 Centrifuge for 5 minutes (until solution is clear) and decant the liquid into a 100 mL volumetric flask.

11.10 Repeat steps 11.5 and 11.6 two more times.

11.11 Dilute to volume with NH₄OAc solution and analyze for sodium by ICP.

12.0 Data Treatment

12.1 Calculations:

$$12.1.1 \quad \text{Ca meq/100 g} = \frac{\text{Ca ppm}}{200}$$

$$12.1.2 \quad \text{Mg meq/100 g} = \frac{\text{Mg ppm}}{122}$$

$$12.1.3 \quad \text{CEC meq/100 g} = \text{Na meq/100 g} = \frac{\text{Na ppm}}{230}$$

13.0 Data Package Deliverables

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13.1 Refer to the CH2M HILL Redding Quality Analytical Laboratories Quality Assurance Plan and to the specific client contract for a listing of deliverables.

14.0 Quality Control Requirements

14.1 All quality control data should be maintained and available for easy reference or inspection.

14.2 Employ a minimum of one blank per sample batch, or for each 20 samples, to determine if contamination or any memory effects are occurring.

14.3 A material of known cation-exchange capacity must be analyzed with each sample batch, or each group of 20 samples, as a Laboratory Control Sample.

15.0 Method Validation

15.1 Each analyst must make an initial, one-time demonstration of the ability to generate acceptable accuracy and precision with this method. This compliance must be documented by the analyst's supervisor or division manager.

16.0 References

16.1 USBR Land Classification Techniques and Standards Release No. 514.8.4 and 514.8.6.

16.2 Method 9081, SW-846, TEST METHODS FOR EVALUATING SOLID WASTE, Volume 1A: Laboratory Manual, Physical/Chemical Methods, Third Edition, USEPA Office of Solid Waste and Emergency Response, November 1986.

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APPENDIX I

Standard Operating Procedure

SOIL ANALYSIS

FOR

CATION-EXCHANGE CAPACITY (SODIUM ACETATE)

LAB Document Control Number LRD I-0069

Revision 1

Approved:

LRD Laboratory Manager

LRD Inorganics Division Manager

LRD LQAC Officer

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**CH2M HILL
MONTGOMERY LABORATORY
STANDARD OPERATING PROCEDURES
WET CHEMISTRY DEPARTMENT**

**METHOD WEAK AND DISSOCIABLE CYANIDE ANALYSIS IN
WATER**

CYANIDE, WEAK AND DISSOCIABLE

Method 335.2 CLP.M* (Titrimetric; Manual Spectrophotometric; Semi-Automated Spectrophotometric)

1. SCOPE AND APPLICATION

- 1.1 This method applies to the determination of cyanide in drinking, surface and saline waters, and domestic and industrial wastes
- 1.2 The titration procedure using silver nitrate with p-dimethylaminobenzalrhodanine indicator is used for measuring concentrations of cyanide exceeding 1 mg/L
- 1.3 The manual colorimetric procedure is used for concentrations below 1 mg/L of cyanide and is sensitive to about 5 ug/L (Option B, 8.3).

2. SUMMARY OF METHOD

- 2.1 Hydrogen cyanide (HCN) is liberated from a slightly acidified (pH 4.5 to 6.0) sample under the prescribed distillation conditions. The methods does not cover CN from right complexes that would not be amenable to oxidation by chlorine. The acetate buffer used contains zinc salts to precipitate iron cyanide as a further assurance of the selectivity of the methods.
- 2.2 In the colorimetric measurement, the cyanide is converted to cyanogen chloride, CNCl, by reaction with chloramine-T at a pH less than 8 without hydrolyzing to the cyanate. After the reaction is complete, color forms upon the addition of pyridinebarbituric acid reagent. The absorbance is read at 578 nm for pyridinebarbituric acid. To obtain colors of comparable intensity, it is essential to have the same salt content in both the sample and the standards.
- 2.3 The titrimetric measurement uses a standard solution of silver nitrate to titrate cyanide in the presence of a silver sensitive indicator.

***CLP-M Modified for Weak and Dissociable Cyanide**

3. DEFINITIONS

- 3.1 Weak and Dissociable Cyanide is defined as cyanide ion converted to hydrocyanic acid (HCN) by reaction in a reflux system with slightly acidified sample.

4. SAMPLE HANDLING AND PRESERVATION

- 4.1 All bottles must be thoroughly cleansed and rinsed to remove soluble material from containers.
- 4.2 Oxidizing agents such as chlorine decompose most of the cyanides. Test a drop of the sample with potassium iodide-starch test paper (KI-starch paper); a blue color indicates the need for treatment. Add ascorbic acid a few crystals at a time until a drop of sample produces no color on the indicator paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume.
- 4.3 Samples are preserved with 2 ml of 10 N sodium hydroxide per liter of sample ($\text{pH} > 12$) at the time of collection (Exhibit D, Section II).
- 4.4 Samples must be stored at 4°C ($\pm 2^{\circ}\text{C}$) and must be analyzed within the holding time specified in Exhibit D, Section II (14 days).

5. INTERFERENCES

- 5.1 Interferences are eliminated or reduced by using the distillation procedure described in Procedure 8.1.
- 5.2 Sulfides adversely affect the colorimetric and titration procedures. If a drop of the distillate on lead acetate test paper shows the presence of sulfides, treat 25 ml more of the sample than that required for the cyanide determination with powdered cadmium carbonate. Yellow cadmium sulfide precipitates if the sample contains sulfide. Repeat this operation until a drop of the treated sample solution does not darken the lead acetate test paper. Filter the solution through a dry filter paper into a dry beaker, and from the filtrate measure the sample to be used for analysis. Avoid a large excess of cadmium carbonate and a long contact time in order to minimize a loss by complexation or occlusion of cyanide on the precipitated material. Sulfides should be removed before the solution is preserved with sodium hydroxide as described in 4.3.
- 5.3 The presence of surfactants may cause the sample to foam during refluxing. If this occurs, adding an agent such as Dow Corning 544 antifoam agent will prevent the foam from collecting in the condenser. Fatty acids will distill and form soaps

under alkaline titration conditions, making the end point almost impossible to detect. When this reaction occurs, one of the spectrophotometric methods should be used.

6. APPARATUS

- 6.1 Reflux distillation apparatus such as shown in Figure 1. The boiling flask should be 1 liter in size with an inlet tube and provision for a condenser.
- 6.2 Microburet, 5.0 ml (for titration)
- 6.3 Spectrophotometer suitable for measurements at 578 nm with a 1.0 cm cell or larger (for manual spectrophotometric method).
- 6.4 Lachat QuikChem Automated Flow Injection Analyzer which includes:
 - 6.4.1 Automatic Sampler
 - 6.4.2 Proportioning Pump
 - 6.4.3 Injection Valve Module with a 150 cm 0.8 mm i.d. sample loop
 - 6.4.4 Flow Cell, 10 mm, 80 uL
 - 6.4.5 Interference Filter Wavelength, 578 nm
 - 6.4.6 Heater Module
 - 6.4.7 Reaction Module 10-204-00-1-A

7. REAGENTS

- 7.1 Distillation and Preparation Reagents
 - 7.1.1 Sodium hydroxide solution 0.25N. Dissolve 20 g of NaOH in distilled water, and dilute to 2 liters with distilled water.
 - 7.1.2 Cadmium carbonate: powdered
 - 7.1.3 Ascorbic acid: crystals
 - 7.1.4 Acetic acid, 1 + 9: Mix 1 volume of glacial acetic acid with 9 volumes of water.
 - 7.1.5 Acetate buffer: Dissolve 410 g sodium acetate trihydrate ($\text{NaC}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$) in 500 mL water. Add glacial acetic acid to yield a solution pH of 4.5 (approximately 500 mL)

Insert Figure 1

DRAFT

- 7.1.6 Zinc acetate solution, 100 g/L: Dissolve 100 g Zn ($C_2H_3O_2$).H₂O in 500 mL water. Dilute to 1 L.
- 7.1.7 Methyl red indicator.
- 7.2 Stock Standards and Titration Reagents
- 7.2.1 Stock cyanide solution: Dissolve 2.51 g of KCN and 2 g KOH in 1 liter of distilled water. Standardize with 0.0192 N AgNO₃.
- 7.2.2 Standard cyanide solution, intermediate: Dilute 50.0 ml of stock (1 ml = 1 mg CN) to 1000 ml with distilled water.
- 7.2.3 Standard silver nitrate solution, 0.0192 N: Prepare by crushing approximately 5 g AgNO₃ crystals and drying to constant weight at 40°C. Weigh out 3.2647 g of dried AgNO₃, dissolve it in distilled water, and dilute it to 1,000 ml (1 ml = 1 mg CN).
- 7.2.4 Rhodanine indicator: Dissolve 20 mg of p-dimethylaminobenzalrhodanine in 100 ml of acetone.
- 7.3 Manual Spectrophotometric Reagents
- 7.3.1 Sodium dihydrogenphosphate, 1 M: Dissolve 138 g of NaH₂PO₄ x H₂O in a liter of distilled water. Refrigerate this solution.
- 7.3.2 Chloramine-T solution: Dissolve 1.0 g of white, water soluble chloramine-T in 100 ml of distilled water and refrigerate until ready to use. Prepare fresh daily.
- 7.3.3 Color Reagent—One of the following may be used:
- 7.3.3.1 Pyridine-barbituric acid reagent: Place 15 g of barbituric acid in a 250 ml volumetric flask and add just enough distilled water to wash the sides of the flask and wet the barbituric acid. Add 75 ml of pyridine and mix. Add 15 ml of HCl (sp gr 1.19), mix, and cool to room temperature. Dilute to 250 ml with distilled water and mix. This reagent is stable for approximately 6 months if stored in a cool, dark place.

7.4 Semi-Automated Spectrophotometric Reagents

- 7.4.1 Chloramine-T solution: Dissolve 0.40 g of chloramine-T in distilled water and dilute to 100 mL. Prepare fresh daily.
- 7.4.2 Phosphate buffer: Dissolve 138 g of $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$ in distilled water and dilute to 1 liter. Add 0.5 mL of Brij-35 (available from Technicon). Store at 4°C ($\pm 2^\circ\text{C}$).
- 7.4.3 Pyridine-barbituric acid solution: Transfer 15 g of barbituric acid into a 1 liter volumetric flask. Add about 100 mL of distilled water and swirl the flask. Add 74 mL of pyridine and mix. Add 15 mL of concentrated HCl and mix. Dilute to about 900 mL with distilled water and mix until the barbituric acid is dissolved. Dilute to 1 liter with distilled water. Store at 4°C ($\pm 2^\circ\text{C}$).
- 7.4.4 Sampler wash: Dissolve 10 g of NaOH in distilled water and dilute to 1 liter.

8. PROCEDURE

8.1 Distillation

- 8.1.1 Place 500 ml of sample, or an aliquot diluted to 500 ml, in the 1 liter boiling flask. Add exactly 100 ml of sodium hydroxide (7.1.1) to the absorbing tube. Connect the boiling flask, condenser, absorber, and trap in the train.
- 8.1.2 Start a slow stream of air entering the boiling flask by adjusting the vacuum source. Adjust the vacuum so that approximately one bubble of air per second enters the boiling flask through the air inlet tube.

NOTE: The bubble rate will not remain constant after the reagents have been added and while heat is being applied to the flask. It will be necessary to readjust the air rate occasionally to prevent the solution in the boiling flask from backing up into the air inlet tube.

- 8.1.3 Add 10mL each of the acetate buffer and zinc acetate solutions through air inlet tube. Also add 2 to 3 drops methyl red indicator. Rinse air inlet tube with water and allow air to mix contents. If the solution is not pink, add acetic acid (1 + 9) dropwise through air inlet tube until a pink color persists.

8.1.4 Heat the solution to boiling, taking care to prevent the solution from backing up into and overflowing from the air inlet tube. Reflux for one hour. Turn off heat and continue the airflow for at least 15 minutes. After cooling the boiling flask, disconnect absorber and close off the vacuum source.

8.2 Titrimetric Determination (Option A)

- 8.2.1 If the sample contains more than 1 mg of CN, transfer the distillate, or a suitable aliquot diluted to 250 ml, to a 500 ml Erlenmeyer flask. Add 10-12 drops of the benzalrhodanine indicator.
- 8.2.2 Titrate with standard silver nitrate to the first change in color from yellow to brownish-pink. Titrate a distilled water blank using the same amount of sodium hydroxide and indicator as in the sample.
- 8.2.3 The analyst should familiarize himself with the end point of the titration and the amount of indicator to be used before actually titrating the samples. A 5 or 10 ml microburet may be conveniently used to obtain a more precise titration.

8.3 Manual Spectrophotometric Determination (Option B)

- 8.3.1 Withdraw 50 ml or less of the solution from the absorbing tube and transfer to a 100 ml volumetric flask. If less than 50 ml is taken, dilute to 50 ml with 0.25 N sodium hydroxide solution. Add 15.0 ml of sodium phosphate solution (7.3.1) and mix.
- 8.3.1.1 Pyridine-barbituric acid method: Add 2 ml of chloramine-T (7.3.2) and mix., After 1 to 2 minutes, add 5 ml of pyridine-barbituric acid solution (7.3.3.1) and mix. Dilute to mark with distilled water and mix again. Allow 8 minutes for color development, then read absorbance at 578 nm in a 1 cm cell within 15 minutes.
- 8.3.2 Prepare a minimum of 5 standards and a blank by pipetting suitable volumes of standard solution into 100 ml volumetric flasks. NOTE: One calibration standard must be at the Contract Required Detection Limit (CRDL). To each standard, add 50 ml of 0.25 N sodium hydroxide. Standards must bracket the concentration of the samples. If dilution is required, use the blank solution.

As an example, standard solutions could be prepared as follows:

<u>ul of Standard Solution</u>	<u>Conc. ug CN</u>
<u>7.2.2</u>	
0	Blank
50	5
100	10
250	25
500	50
1,000	100

8.3.2.1 It is not imperative that all standards be distilled in the same manner as the samples. At least one standard (mid-range) must be distilled and compared to similar values on the curve to ensure that the distillation technique is reliable. If the distilled standard does not agree with $\pm 15\%$ of the undistilled standards, the operator should find and correct the cause of the apparent error before proceeding.

8.3.2.2 Prepare a standard curve by plotting absorbance of standard vs. cyanide concentrations.

8.4 Semi-Automatic Spectrophotometric Determination (Option C)

8.4.1 Set up the manifold as shown in manifold diagram. Pump the reagents through the system until a steady baseline is obtained.

8.4.2 Calibration standards: Prepare a blank and at least five calibration standards over the range of the analysis. One calibration standard must be at the CRRL. For a working range of 0-200 ug/L, the following standards may be used.

8.4.2.1 It is not imperative that all standards be distilled in the same manner as the samples. At least one standard (mid-range) must be distilled and compared to similar values on the curve to ensure that the distillation technique is reliable. If the distilled standard does not agree within ± 15 percent of the undistilled standards, the operator should find and correct the cause of the apparent error before proceeding.

<u>uL Standard Solution (7.2.2) diluted to 100 ml</u>	<u>Concentration ug CN/L</u>
---	----------------------------------

0	0
50	2.5
100	5.0
200	10.0
500	25.0
1,000	50.0
2,000	100.0

Add 1.0 g of NaOH to each standard. Store at 4°C (±2°C).

8.4.3 Place calibration standards, blanks, and control standards in the sampler tray, followed by distilled samples, distilled duplicates, distilled standards, distilled spikes, and distilled blanks.

8.4.4 Set Injection Timing With:

8.4.4.1 Pump speed: 35
8.4.4.2 Cycle period: 40 s
8.4.4.3 Sample Loop Length: 150 cm
8.4.4.4 Load period: 20 s
8.4.4.5 Inject period: 20 s
8.4.4.6 Inject to start of peak period: 25 s
8.4.4.7 Inject to end of peak period: 61 s

8.4.5 Set System IV Gain: 340 x 1

8.4.6 System operation

8.4.6.1 Inspect modules for proper connections.

8.4.6.2 Turn on power to all modules. Allow heater to warm up to 60°C.

8.4.6.3 Place reagent transmission lines into proper containers. Rain tension levers on pump tube cassettes.

8.4.6.4 Pump system until a stable baseline is attained.

- 8.4.6.5 Set baseline. If necessary, manually inject a high standard to set gain on colorimeter.
- 8.4.6.6 Program data system to initial parameters or those empirically determined.
- 8.4.6.7 Place calibration standards and blank in sample tray in descending order of concentration followed by unknowns, and check standards.
- 8.4.6.8 At end of run, place all transmission lines in water, flush system and pump dry.
- 8.4.6.9 Turn off pump, all modules, and release pump tube cassettes.

9. CALCULATIONS

9.1 Using the titrimetric procedure, calculate concentration of CN as follows:

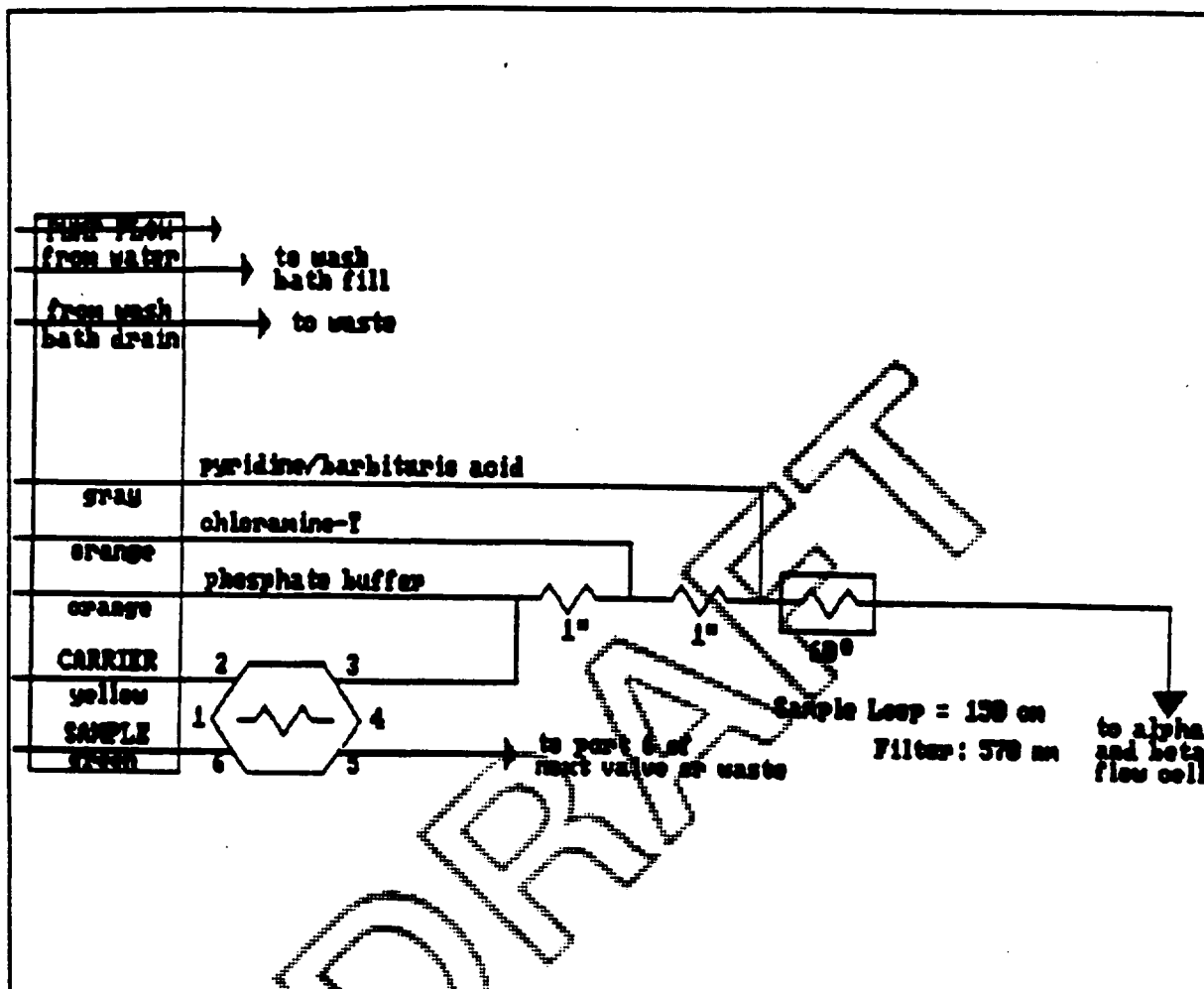
$$\text{CN, mg/L} = \frac{(A-B) 1,000 \text{ ml/L} \times 100 \text{ ml}}{\text{ml orig. sample} \times \text{ml of aliquot titrated}}$$

where: A = volume of AgNO₃ for titration of sample
(1 ml = 1 mg Ag)

B = volume of AgNO₃ for titration of blank
(1 ml = 1 mg Ag)

AND: 100 ml = distillate volume (see 8.1.5)
1,000 ml = conversion ml to L
ml original sample (See 8.1.1)
ml of aliquot titrated (See 8.2.1)

Manifold Diagram



CARRIER is 0.25 M sodium hydroxide, Reagent 1.

1"	is	70.0	cm of tubing on a 1 in coil support
2"	is	135	cm of tubing on a 2 in coil support
2.5"	is	168	cm of tubing on a 2.5 in coil support
3"	is	202	cm of tubing on a 3 in coil support
4"	is	255	cm of tubing on a 4 in coil support
8"	is	550	cm of tubing on a 8 in coil support

Heated tubing is shown inside a box with the temperature next to the box. heated tubing is 650 cm unless otherwise specified.

All manifold tubing is 0.8 mm (0.032 in) i.d. This is 5.2 uL/cm.

Attachment 4

DNAPL Investigation Guidance



Ground Water Issue

DENSE NONAQUEOUS PHASE LIQUIDS

Scott G. Huling* and James W. Weaver**

Background

The Regional Superfund Ground Water Forum is a group of EPA professionals representing EPA's Regional Superfund Offices, committed to the identification and the resolution of ground water issues impacting the remediation of Superfund sites. The Forum is supported by and advises the Superfund Technical Support Project. Dense nonaqueous phase liquids is an issue identified by the Forum as a concern of Superfund decision-makers. For further information contact Scott G. Huling (FTS:743-2313), Jim Weaver (FTS:743-2420), or Randall R. Ross (FTS: 743-2355).

Introduction

Dense nonaqueous phase liquids (DNAPLs) are present at numerous hazardous waste sites and are suspected to exist at many more. Due to the numerous variables influencing DNAPL transport and fate in the subsurface, and consequently, the ensuing complexity, DNAPLs are largely undetected and yet are likely to be a significant limiting factor in site remediation. This issue paper is a literature evaluation focusing on DNAPLs and provides an overview from a conceptual fate and transport point of view of DNAPL phase distribution, monitoring, site characterization, remediation, and modeling.

Nonaqueous phase liquid (NAPL) is a term used to describe the physical and chemical differences between a hydrocarbon liquid and water which result in a physical interface between a mixture of the two liquids. The interface is a physical dividing surface between the bulk phases of the two liquids, but compounds found in the NAPL are not prevented from solubilizing into the ground water. Immiscibility is typically determined based on the visual observation of a physical interface in a water-hydrocarbon mixture. There are numerous methods, however, which are used to quantify the physical and chemical properties of hydrocarbon liquids (31).

Nonaqueous phase liquids have typically been divided into two general categories, dense and light. These terms describe the specific gravity, or the weight of the nonaqueous phase liquid relative to water. Correspondingly, the dense nonaqueous

phase liquids have a specific gravity greater than water, and the light nonaqueous phase liquids (LNAPL) have a specific gravity less than water.

Several of the most common compounds associated with DNAPLs found at Superfund sites are included in Table 1. These compounds are a partial list of a larger list identified by a national screening of the most prevalent compounds found at Superfund sites (65). The general chemical categories are halogenated/non-halogenated semi-volatiles and halogenated volatiles. These compounds are typically found in the following wastes and waste-producing processes: solvents, wood preserving wastes (creosote, pentachlorophenol), coal tars, and pesticides. The most frequently cited group of these contaminants to date are the chlorinated solvents.

DNAPL Transport and Fate - Conceptual Approach

Fate and transport of DNAPLs in the subsurface will be presented from a conceptual point of view. Figures have been selected for various spill scenarios which illustrate the general behavior of DNAPL in the subsurface. Following the conceptual approach, detailed information will be presented explaining the specific mechanisms, processes, and variables which influence DNAPL fate and transport. This includes DNAPL characteristics, subsurface media characteristics, and saturation dependent parameters.

Unsaturated Zone

Figure 1 indicates the general scenario of a release of DNAPL into the soil which subsequently migrates vertically under both the forces of gravity and soil capillarity. Soil capillarity is also responsible for the lateral migration of DNAPL. A point is reached at which the DNAPL no longer holds together as a continuous phase, but rather is present as isolated residual globules. The fraction of the hydrocarbon that is retained by capillary forces in the porous media is referred to as residual

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Table 1. Most prevalent chemical compounds at U.S. Superfund Sites (65) with a specific gravity greater than one.

Compound	Density [1]	Dynamic[2] Viscosity	Kinematic Viscosity[3]	Water[4] Solub.	Henry's Law Constant[5]	Vapor[6] Pressure
Halogenated Semi-volatiles						
1,4-Dichlorobenzene	1.2475	1.2580	1.008	8.0 E+01	1.58 E-03	6 E-01
1,2-Dichlorobenzene	1.3060	1.3020	0.997	1.0 E+02	1.88 E-03	9.6 E-01
Aroclor 1242	1.3850			4.5 E-01	3.4 E-04	4.06 E-04
Aroclor 1260	1.4400			2.7 E-03	3.4 E-04	4.05 E-05
Aroclor 1254	1.5380			1.2 E-02	2.8 E-04	7.71 E-05
Chlordane	1.6	1.1040	0.69	5.6 E-02	2.2 E-04	1 E-05
Dieldrin	1.7500			1.86 E-01	9.7 E-06	1.78 E-07
2,3,4,6-Tetrachlorophenol	1.8390			1.0 E+03		
Pentachlorophenol	1.9780			1.4 E+01	2.8 E-06	1.1 E-04
Halogenated Volatiles						
Chlorobenzene	1.1060	0.7560	0.683	4.9 E+02	3.46 E-03	8.8 E+00
1,2-Dichloropropane	1.1580	0.8400	0.72	2.7 E+03	3.6 E-03	3.95 E+01
1,1-Dichloroethane	1.1750	0.3770	0.321	5.5 E+03	5.45 E-04	1.82 E+02
1,1-Dichloroethylene	1.2140	0.3300	0.27	4.0 E+02	1.49 E-03	5 E+02
1,2-Dichloroethane	1.2530	0.8400	0.67	8.69 E+03	1.1 E-03	6.37 E+01
Trans-1,2-Dichloroethylene	1.2570	0.4040	0.321	6.3 E+03	5.32 E-03	2.65 E+02
Cis-1,2-Dichloroethylene	1.2480	0.4670	0.364	3.5 E+03	7.5 E-03	2 E+02
1,1,1-Trichloroethane	1.3250	0.8580	0.647	9.5 E+02	4.08 E-03	1 E+02
Methylene Chloride	1.3250	0.4300	0.324	1.32 E+04	2.57 E-03	3.5 E+02
1,1,2-Trichloroethane	1.4436	0.1190	0.824	4.5 E+03	1.17 E-03	1.30 E+01
Trichloroethylene	1.4620	0.5700	0.390	1.0 E+03	8.92 E-03	5.87 E+01
Chloroform	1.4850	0.5630	0.379	8.22 E+03	3.75 E-03	1.6 E+02
Carbon Tetrachloride	1.5947	0.9650	0.605	8.0 E+02	2.0 E-02	9.13 E+01
1,1,2,2-Tetrachloroethane	1.6	1.7700	1.10	2.9 E+03	5.0 E-04	4.9 E+00
Tetrachloroethylene	1.6250	0.8900	0.54	1.5 E+02	2.27 E-02	1.4 E+01
Ethylene Dibromide	2.1720	1.6760	0.79	3.4 E+03	3.18 E-04	1.1 E+01
Non-halogenated Semi-volatiles						
2-Methyl Naphthalene	1.0058			2.54 E+01	5.06 E-02	6.80 E-02
o-Cresol	1.0273			3.1 E+04	4.7 E-05	2.45 E-01
p-Cresol	1.0347			2.4 E+04	3.5 E-04	1.08 E-01
2,4-Dimethylphenol	1.0360			6.2 E+03	2.5 E-06	9.8 E-02
m-Cresol	1.0380	21.0	20	2.35 E+04	3.8 E-05	1.53 E-01
Phenol	1.0576		3.87	8.4 E+04	7.8 E-07	5.293E-01
Naphthalene	1.1620			3.1 E+01	1.27 E-03	2.336E-01
Benzo(a)Anthracene	1.1740			1.4 E-02	4.5 E-06	1.16 E-09
Fluorene	1.2030			1.9 E+00	7.65 E-05	6.67 E-04
Acenaphthene	1.2250			3.88 E+00	1.2 E-03	2.31 E-02
Anthracene	1.2500			7.5 E-02	3.38 E-05	1.08 E-05
Dibenz(a,h)Anthracene	1.2520			2.5 E-03	7.33 E-08	1 E-10
Fluoranthene	1.2520			2.65 E-01	6.5 E-06	E-02 E-06
Pyrene	1.2710			1.48 E-01	1.2 E-05	6.67 E-06
Chrysene	1.2740			6.0 E-03	1.05 E-06	6.3 E-09
2,4-Dinitrophenol	1.6800			6.0 E+03	6.45 E-10	1.49 E-05
Miscellaneous						
Coal Tar	1.028 ⁽⁷⁾	18.98 ⁽⁷⁾				
Creosote	1.05	1.08 ⁽⁷⁾				

[1] g/cc
[2] centipoise (cp), water has a dynamic viscosity of 1 cp at 20°C.
[3] centistokes (cs)
[4] mg/l

[5] atm-m³/mol
[6] mm Hg
[7] 45° F (70)
[8] 15.5°C, varies with creosote mix (62)

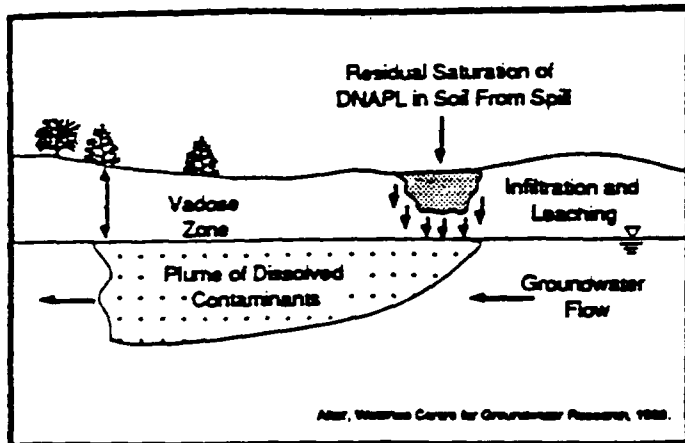


Figure 1. The entire volume of DNAPL is exhausted by residual saturation in the vadose zone prior to DNAPL reaching the water table. Soluble phase compounds may be leached from the DNAPL residual saturation and contaminate the ground water.

saturation. In this spill scenario, the residual saturation in the unsaturated zone exhausted the volume of DNAPL, preventing it from reaching the water table. This figure also shows the subsequent leaching (solubilization) of the DNAPL residual saturation by water percolating through the unsaturated zone (vadose zone). The leachate reaching the saturated zone results in ground-water contamination by the soluble phase components of the hydrocarbon. Additionally, the residual saturation at or near the water table is also subjected to leaching from the rise and fall of the water table (seasonal, sea level, etc.).

Increasing information is drawing attention to the importance of the possibility that gaseous-phase vapors from NAPL in the unsaturated zone are responsible for contaminating the ground water and soil (18,47). It is reported that the greater "relative vapor density" of gaseous vapors to air will be affected by gravity and will tend to sink. In subsurface systems where lateral spreading is not restricted, spreading of the vapors may occur as indicated in Figure 2. The result is that a greater amount of soils and ground water will be exposed to the DNAPL vapors and may result in further contamination. The extent of contamination will depend largely on the partitioning of the DNAPL vapor phase between the aqueous and solid phases.

DNAPL Phase Distribution - Four Phase System

It is apparent from Figures 1 and 2 that the DNAPL may be present in the subsurface in various physical states or what is referred to as phases. As illustrated in Figure 3, there are four possible phases: gaseous, solid, water, and immiscible hydrocarbon (DNAPL) in the unsaturated zone. Contaminants associated with the release of DNAPL can, therefore, occur in four phases described as follows:

1. Air phase - contaminants may be present as vapors;
2. Solid phase - contaminants may adsorb or partition onto the soil or aquifer material;
3. Water phase - contaminants may dissolve into the water according to their solubility; and

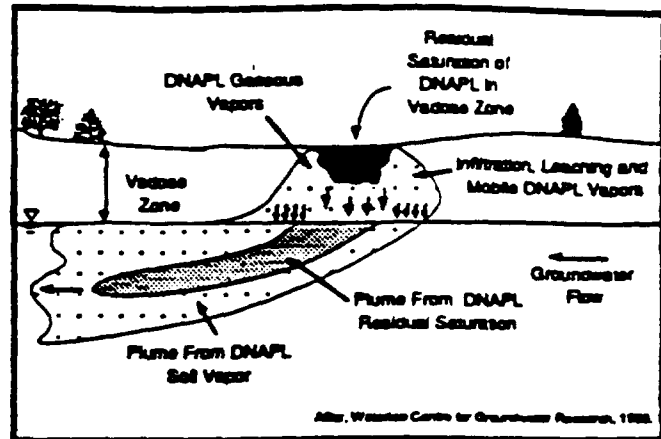


Figure 2. Migration of DNAPL vapors from the spill area and subsequent contamination of the soils and ground water.

4. Immiscible phase - contaminants may be present as dense nonaqueous phase liquids.

The four phase system is the most complex scenario because there are four phases and the contaminant can partition between any one or all four of these phases, as illustrated in Figure 4. For example, TCE introduced into the subsurface as a DNAPL may partition onto the soil phase, volatilize into the soil gas, and solubilize into the water phase resulting in contamination in all four phases. TCE can also partition between the water and soil, water and air, and between the soil and air. There are six pathways of phase distribution in the unsaturated zone. The distribution of a contaminant between these phases can be represented by empirical relationships referred to as partition coefficients. The partition coefficients, or the distribution of the DNAPL between the four phases, is highly site-specific and highly dependent on the characteristics of both the soil/aquifer matrix and the DNAPL. Therefore, the distribution between phases may change with time and/or location at the same site and during different stages of site remediation.

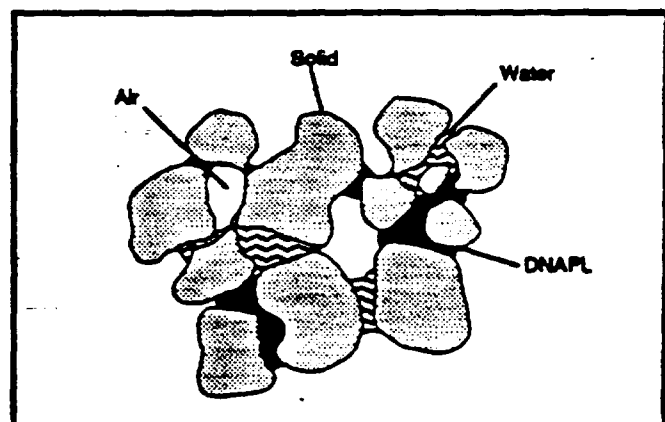


Figure 3. A DNAPL contaminated unsaturated zone has four physical states or phases (air, solid, water, immiscible). The contaminant may be present in any one, or all four phases.

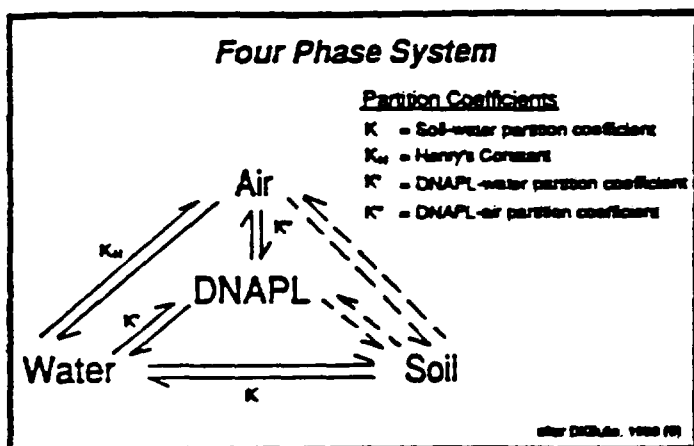


Figure 4. Distribution of DNAPL between the four phases found in the vadose zone.

The concept of phase distribution is critical in decision-making. Understanding the phase distribution of a DNAPL introduced into the subsurface provides significant insight in determining which tools are viable options with respect to site characterization and remediation.

DNAPL represented by residual saturation in the four phase diagram is largely immobile under the usual subsurface pressure conditions and can migrate further only: 1) in water according to its solubility; or 2) in the gas phase of the unsaturated zone (47). DNAPL components adsorbed onto the soil are also considered immobile. The mobile phases are, therefore, the soluble and volatile components of the DNAPL in the water and air, respectively.

The pore space in the unsaturated zone may be filled with one or all three fluid phases (gaseous, aqueous, immiscible). The presence of DNAPL as a continuous immiscible phase has the potential to be mobile. The mobility of DNAPL in the subsurface must be evaluated on a case by case basis. The maximum number of potentially mobile fluid phases is three. Simultaneous flow of the three phases (air, water, and immiscible) is considerably more complicated than two-phase flow (46). The mobility of three phase flow in a four-phase system is complex, poorly understood, and is beyond the scope of this DNAPL overview. The relative mobility of the two phases, water and DNAPL, in a three-phase system is presented below in the section entitled "Relative Permeability."

Generally, rock aquifers contain a myriad of cracks (fractures) of various lengths, widths, and apertures (32). Fractured rock systems have been described as rock blocks bounded by discrete discontinuities comprised of fractures, joints, and shear zones which may be open, mineral-filled, deformed, or any combination thereof (61). The unsaturated zone overlying these fractured rock systems also contain the myriad of preferential pathways. DNAPL introduced into such formations (Figure 5) follow complex pathways due to the heterogeneous distribution of the cracks, conduits, and fractures, i.e., preferential pathways. Transport of DNAPL may follow non-Darcian flow in the open fractures and/or Darcian flow in the porous media filled fractures. Relatively small volumes of DNAPL may move deep, quickly into the rock because the

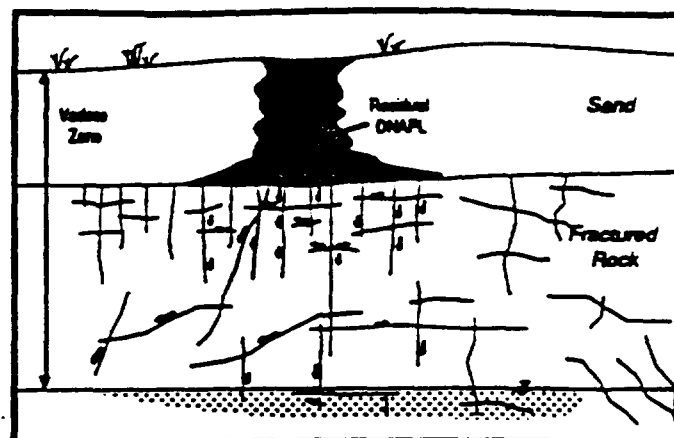


Figure 5. DNAPL spilled into fractured rock systems may follow a complex distribution of the preferential pathways.

retention capacity offered by the dead-end fractures and the immobile fragments and globules in the larger fractures is so small (32). Currently, the capability to collect the detailed information for a complete description of a contaminated fractured rock system is regarded as neither technically possible nor economically feasible (61).

Low permeability stratigraphic units such as high clay content formations may also contain a heterogeneous distribution of preferential pathways. As illustrated in Figure 6, DNAPL transport in these preferential pathways is correspondingly complex. Typically, it is assumed that high clay content formations are impervious to DNAPL. However, as DNAPL spreads out on low permeable formations it tends to seek out zones of higher permeability. As a result, preferential pathways allow the DNAPL to migrate further into the low permeable formation, or through it to underlying stratigraphic units. It is apparent from Figures 5 and 6 that the complexity of DNAPL transport may be significant prior to reaching the water table.

Saturated Zone

The second general scenario is one in which the volume of DNAPL is sufficient to overcome the fraction depleted by the residual saturation in the vadose zone, as illustrated in Figure 7. Consequently, the DNAPL reaches the water table and contaminates the ground water directly. The specific gravity of DNAPL is greater than water, therefore, the DNAPL migrates into the saturated zone. In this scenario, DNAPL continues the vertical migration through the saturated zone until the volume is eventually exhausted by the residual saturation process or until it is intercepted by a low permeable formation where it begins to migrate laterally.

DNAPL Phase Distribution - Three Phase System

Due to the lack of the gaseous phase, the saturated zone containing DNAPL is considered a three-phase system consisting of the solid, water, and immiscible hydrocarbon (Figure 8). Contaminant distribution in the three-phase system is less complex than the four-phase system. Again, this is highly dependent on the characteristics of both the aquifer

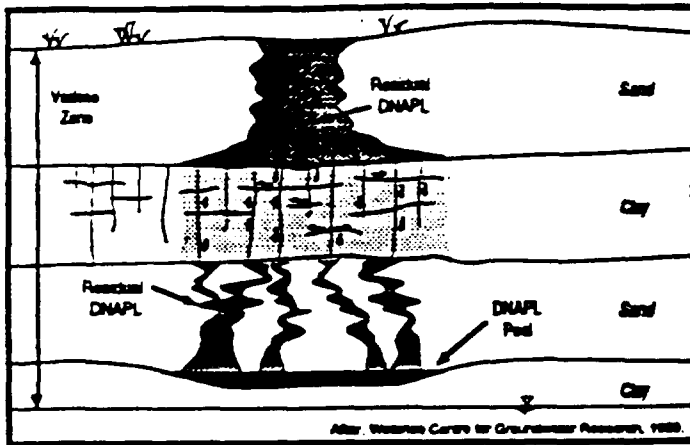


Figure 6. DNAPL spilled into a low permeable formation may follow a complex distribution of preferential pathways. The volume of DNAPL is exhausted in the vadose zone prior to reaching the water table.

matrix and the DNAPL. Figure 9 indicates the three phases and the transfer of the mass of contaminant between the phases. In this scenario, there are only three pathways of phase distribution in the saturated zone.

Note that when the DNAPL is represented by residual saturation in the three-phase system, the mobile phase of the contaminant is the water soluble components of the DNAPL and the immobile phases are the residual saturation and the adsorbed components of the DNAPL associated with the aquifer material. The main mobilization mechanism of the residual saturation is removal of soluble phase components into the ground water. When the DNAPL is present as a continuous immiscible phase, it too is considered one of the mobile phases of the contaminant. While the continuous phase DNAPL has the potential to be mobile, immobile continuous phase DNAPL may also exist in the subsurface. Although the saturated zone is considered a three-phase system, gaseous vapors from DNAPL in the unsaturated zone does have the

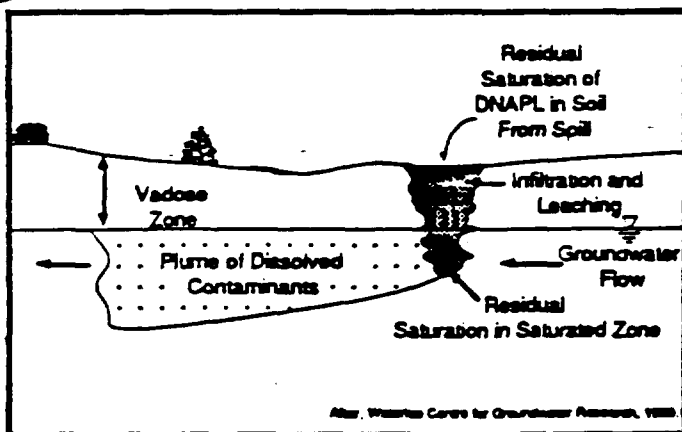


Figure 7. The volume of DNAPL is sufficient to overcome the residual saturation in the vadose zone and consequently penetrates the water table.

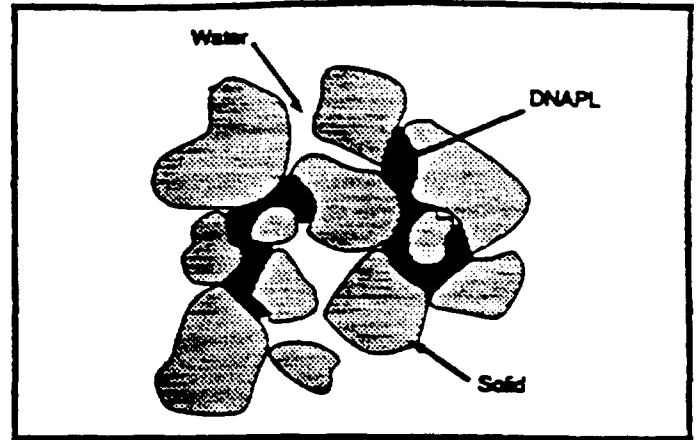


Figure 8. A DNAPL contaminated saturated zone has three phases (solid, water, immiscible). The contaminant may be present in any one, or all three phases.

potential to affect ground-water quality, as was indicated earlier in Figure 2.

Assuming the residual saturation in the saturated zone does not deplete the entire volume of the DNAPL, the DNAPL will continue migrating vertically until it encounters a zone or stratigraphic unit of lower permeability. Upon reaching the zone of lower permeability, the DNAPL will begin to migrate laterally. The hydraulic conductivity in the vertical direction is typically less than in the horizontal direction. It is not uncommon to find vertical conductivity that is one-fifth or one-tenth the horizontal value (4). It is expected that DNAPL spilled into the subsurface will have a significant potential to migrate laterally. If the lower permeable boundary is "bowl shaped", the DNAPL will pond as a reservoir (refer to Figure 10). As illustrated in Figure 11, it is not uncommon to observe a perched DNAPL reservoir where a discontinuous impermeable layer, i.e., silt or clay lens, intercepts the vertical migration of DNAPL. When a sufficient volume of DNAPL has been released and multiple discontinuous impermeable layers exist, the DNAPL may be present in several perched reservoirs as well as a deep

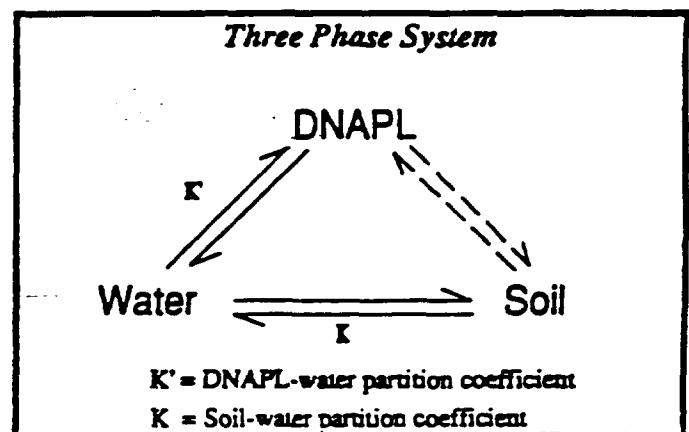


Figure 9. Distribution of DNAPL between the three phases found in the saturated zone.

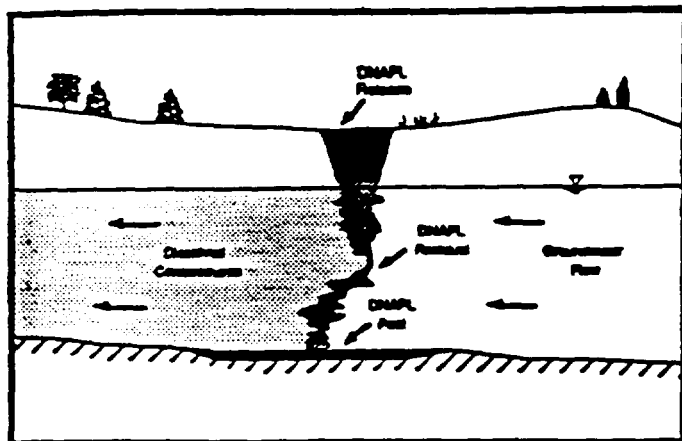


Figure 10. Migration of DNAPL through the vadose zone to an impermeable boundary.

reservoir (refer to Figure 12). Lateral migration continues until either the residual saturation depletes the DNAPL or an impermeable depression immobilizes the DNAPL in a reservoir type scenario. Soluble-phase components of the DNAPL will partition into the ground water from both the residual saturation or DNAPL pools. The migration of DNAPL vertically through the aquifer results in the release of soluble-phase components of the DNAPL across the entire thickness of the aquifer. Note, that ground water becomes contaminated as it flows through, and around, the DNAPL contamination zone.

As indicated earlier, DNAPL will migrate laterally upon reaching a stratigraphic unit of lower permeability. Transport of DNAPL will therefore be largely dependent on the gradient of the stratigraphy. Occasionally, the directional gradient of an impermeable stratigraphic unit may be different than the direction of ground-water flow as illustrated in Figure 13a. This may result in the migration of the continuous phase DNAPL in a direction different from the ground-water flow. Nonhorizontal stratigraphic units with varying hydraulic conductivity may also convey DNAPL in a different direction than ground-water flow, and at different rates (refer to Figure 13b). Determination of the direction of impermeable stratigraphic units will therefore provide useful information concerning the direction of DNAPL transport.

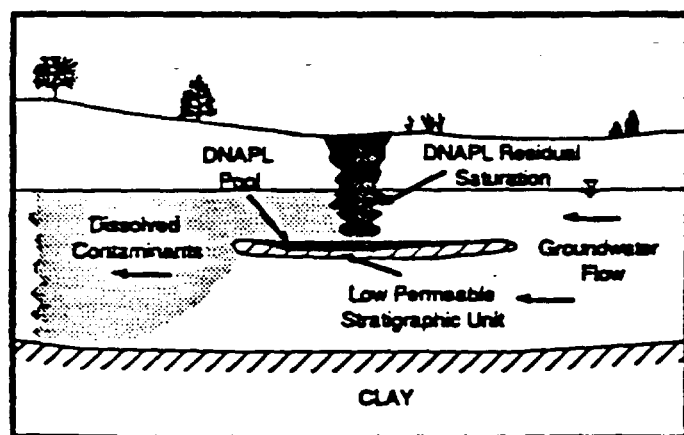


Figure 11. Perched DNAPL reservoir.

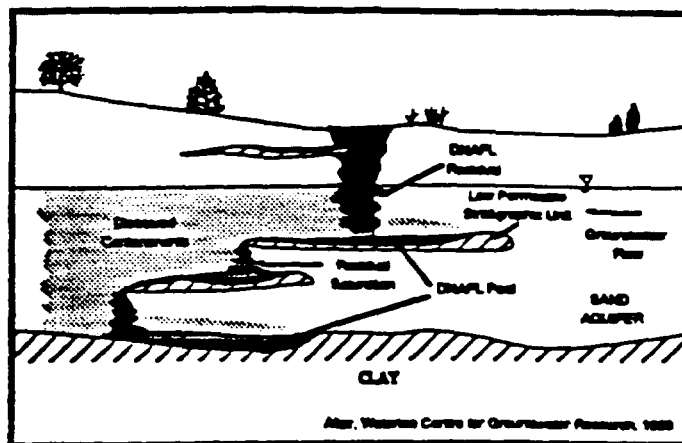


Figure 12. Perched and deep DNAPL reservoirs.

Similar to the unsaturated zone, the saturated zone also contains a complex distribution of preferential pathways from cracks, fractures, joints, etc. DNAPL introduced into such formations correspondingly follow the complex network of pathways through an otherwise relatively impermeable rock material. Other pathways which may behave as vertical conduits for DNAPL include root holes, stratigraphic windows, disposal wells, unsealed geotechnical boreholes, improperly sealed hydrogeological investigation sampling holes and monitoring wells, and old uncased/unsealed water supply wells (72). Transport of the DNAPL may migrate very rapidly in these open conduits or follow Darcian flow in the surrounding porous media or porous media filled fractures. A relatively small volume of DNAPL can move deep into a fractured system due to the low retentive capacity of the fractured system. Consequently, fractured clay or rock stratigraphic units, which are often considered lower DNAPL boundary conditions, may have preferential pathways leading to lower formations, as depicted in Figure 14. Careful inspection of soil cores at one Superfund site indicated that DNAPL flow mainly occurred through preferential pathways and was not uniformly distributed throughout the soil mass (8). Due to the complex

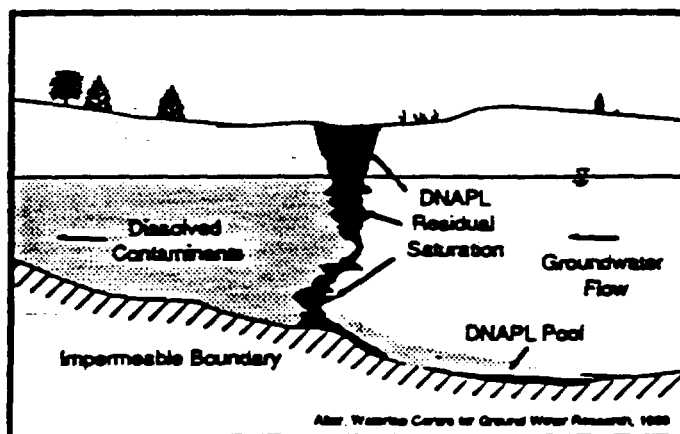


Figure 13a. Stratigraphic gradient different from ground water gradient results in a different direction of flow of the ground water and continuous phase DNAPL.

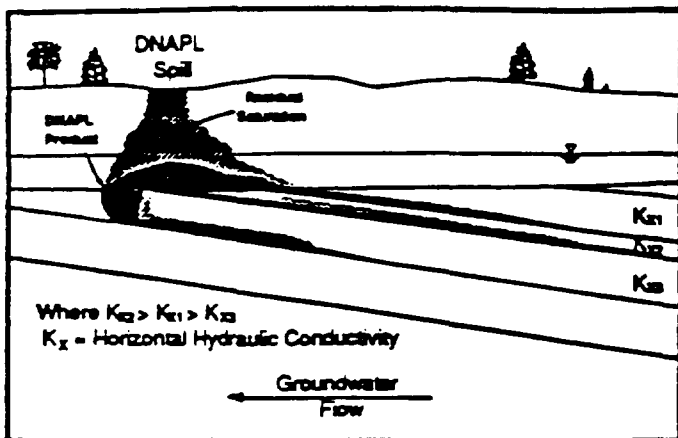


Figure 13b. Non-horizontal stratigraphic units with variable hydraulic conductivity may convey DNAPL in a different direction than the ground water flow direction.

distribution of preferential pathways, characterization of the volume distribution of the DNAPL is difficult.

Important DNAPL Transport and Fate Parameters

There are several characteristics associated with both the subsurface media and the DNAPL which largely determine the fate and transport of the DNAPL. A brief discussion of these parameters is included to help identify the specific details of DNAPL transport mechanisms. Several of the distinctive DNAPL phenomena observed on the field-scale relates back to phenomena at the pore-scale. Therefore, it is important to understand the principles from the pore-scale level to develop an understanding of field-scale observations, which is the scale at which much of the Superfund work occurs. A more complete and comprehensive review of these parameters is available (2,36,71).

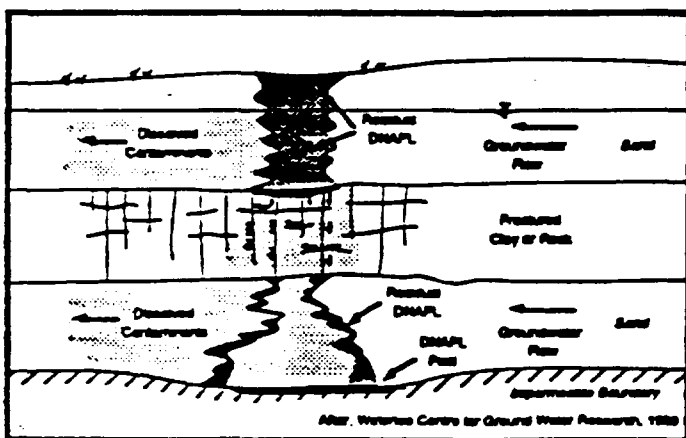


Figure 14. DNAPL transport in fracture and porous media stratigraphic units.

DNAPL Characteristics

Density

Fluid density is defined as the mass of fluid per unit volume, i.e. g/cm^3 . Density of an immiscible hydrocarbon fluid is the parameter which delineates LNAPL's from DNAPL's. The property varies not only with molecular weight but also molecular interaction and structure. In general, the density varies with temperature and pressure (2). Equivalent methods of expressing density are specific weight and specific gravity. The specific weight is defined as the weight of fluid per unit volume, i.e. lb/ft^3 . The specific gravity (S.G.) or the relative density of a fluid is defined as the ratio of the weight of a given volume of substance at a specified temperature to the weight of the same volume of water at a given temperature (31). The S.G. is a relative indicator which ultimately determines whether the fluid will float ($\text{S.G.} < 1.0$) on, or penetrate into ($\text{S.G.} > 1.0$) the water table. Table 1 contains a list of compounds with a density greater than one that are considered DNAPL's. Note, however, that while the specific gravity of pentachlorophenol and the non-halogenated semi-volatiles is greater than 1.00, these compounds are a solid at room temperature and would not be expected to be found as an immiscible phase liquid at wood preserving sites but are commonly found as contaminants. Pentachlorophenol is commonly used as a wood preservative and is typically dissolved (4-7%) in No. 2 or 3 fuel oil.

Viscosity

The viscosity of a fluid is a measure of its resistance to flow. Molecular cohesion is the main cause of viscosity. As the temperature increases in a liquid, the cohesive forces decrease and the absolute viscosity decreases. The lower the viscosity, the more readily a fluid will penetrate a porous media. The hydraulic conductivity of porous media is a function of both the density and viscosity of the fluid as indicated in equation [1]. It is apparent from this equation that fluids with either a viscosity less than water or fluids with a density greater than water have the potential to be more mobile in the subsurface, than water.

$$K = \frac{k \rho g}{\mu} \quad \text{where,} \quad \begin{array}{l} K = \text{hydraulic conductivity} \\ k = \text{intrinsic permeability} \\ \rho = \text{fluid mass density} \\ g = \text{gravity} \\ \mu = \text{dynamic (absolute) viscosity} \end{array} \quad [1]$$

Results from laboratory experiments indicated that several chlorinated hydrocarbons which have low viscosity (methylene chloride, perchloroethylene, 1,1,1-TCA, TCE) will infiltrate into soil notably faster than will water (47). The relative value of NAPL viscosity and density, to water, indicates how fast it will flow in porous media (100% saturated) with respect to water. For example, several low viscosity chlorinated hydrocarbons (TCE, tetrachloroethylene, 1,1,1-TCA, Methylene Chloride, Chloroform, Carbon Tetrachloride, refer to Table 1) will flow 1.5-3.0 times as fast as water and higher viscosity compounds including light heating oil, diesel fuel, jet fuel, and crude oil (i.e. LNAPL's) will flow 2-10 times slower than water (45). Both coal tar and creosote typically have a specific gravity greater than one and a viscosity greater than water. It is interesting to note

that the viscosity of NAPL may change with time (36). As fresh crude oils lose the lighter volatile components from evaporation, the oils become more viscous as the heavier components compose a larger fraction of the oily mixture resulting in an increase in viscosity.

Solubility

When an organic chemical is in physical contact with water, the organic chemical will partition into the aqueous phase. The equilibrium concentration of the organic chemical in the aqueous phase is referred to as its solubility. Table 1 presents the solubility of several of the most commonly found DNAPL's at EPA Superfund Sites. The solubility of organic compounds varies considerably from the infinitely miscible compounds, including alcohols (ethanol, methanol) to extremely low solubility compounds such as polynuclear aromatic compounds.

Numerous variables influence the solubility of organic compounds. The pH may affect the solubility of some organic compounds. Organic acids may be expected to increase in solubility with increasing pH, while organic bases may act in the opposite way (31). For example, pentachlorophenol is an acid which is ionized at higher pH's. In the ionized form, pentachlorophenol would be more soluble in water (59). Solubility in water is a function of the temperature, but the strength and direction of this function varies. The presence of dissolved salts or minerals in water leads to moderate decreases in solubility (31). In a mixed solvent system, consisting of water and one or more water-miscible compounds, as the fraction of the cosolvent in the mixture increases, the solubility of the organic chemical increases exponentially (12). In general, the greater the molecular weight and structural complexity of the organic compound, the lower the solubility.

Organic compounds are only rarely found in ground water at concentrations approaching their solubility limits, even when organic liquid phases are known or suspected to be present. The observed concentrations are usually more than a factor of 10 lower than the solubility presumably due to diffusional limitations of dissolution and the dilution of the dissolved organic contaminants by dispersion (74). This has also been attributed to: reduced solubility due to the presence of other soluble compounds, the heterogeneous distribution of DNAPL in the subsurface, and dilution from monitoring wells with long intake lengths (10). Detection of DNAPL components in the subsurface below the solubility should clearly not be interpreted as a negative indicator for the presence of DNAPL.

In a DNAPL spill scenario where the DNAPL or its vapors are in contact with the ground water, the concentration of the soluble phase components may range from non-detectable up to the solubility of the compound. The rate of dissolution has been expressed as a function of the properties of the DNAPL components (solubility), ground water flow conditions, differential between the actual and solubility concentration, and the contact area between the DNAPL and the ground water (10). The contact area is expected to be heterogeneous and difficult to quantify. Additionally, as the time of contact increases between the DNAPL and the water, the concentration in the aqueous phase increases.

Vapor Pressure

The vapor pressure is that characteristic of the organic chemical which determines how readily vapors volatilize or evaporate from the pure phase liquid. Specifically, the partial pressure exerted at the surface by these free molecules is known as the vapor pressure (30). Molecular activity in a liquid tends to free some surface molecules and this tendency towards vaporization is mainly dependent on temperature. The vapor pressure of DNAPL's can actually be greater than the vapor pressure of volatile organic compounds. For example, at 20 C, the ratio of the vapor pressures of TCE and benzene is 1.4 (1).

Volatility

The volatility of a compound is a measure of the transfer of the compound from the aqueous phase to the gaseous phase. The transfer process from the water to the atmosphere is dependent on the chemical and physical properties of the compound, the presence of other compounds, and the physical properties (velocity, turbulence, depth) of the water body and atmosphere above it. The factors that control volatilization are the solubility, molecular weight, vapor pressure, and the nature of the air-water interface through which it must pass (31). The Henry's constant is a valuable parameter which can be used to help evaluate the propensity of an organic compound to volatilize from the water. The Henry's law constant is defined as the vapor pressure divided by the aqueous solubility. Therefore, the greater the Henry's law constant, the greater the tendency to volatilize from the aqueous phase. Refer to Table 1.

Interfacial Tension

The unique behavior of DNAPLs in porous media is largely attributed to the interfacial tension which exists between DNAPL and water, and between DNAPL and air. These interfacial tensions, result in distinct interfaces between these fluids at the pore-scale. When two immiscible liquids are in contact, there is an interfacial energy which exists between the fluids resulting in a physical interface. The interfacial energy arises from the difference between the inward attraction of the molecules in the interior of each phase and those at the surface of contact (2). The greater the interfacial tension between two immiscible liquids; the less likely emulsions will form; emulsions will be more stable if formed, and the better the phase separation after mixing. The magnitude of the interfacial tension is less than the larger of the surface tension values for the pure liquids, because the mutual attraction of unlike molecules at the interface reduces the large imbalance of forces (31). Interfacial tension decreases with increasing temperature, and may be affected by pH, surfactants, and gases in solution (36). When this force is encountered between a liquid and a gaseous phase, the same force is called the surface tension (55).

The displacement of water by DNAPL and the displacement of DNAPL by water in porous media often involves a phenomena referred to as immiscible fingering. The lower the interfacial tension between immiscible fluids, the greater the instability of the water:DNAPL interface and thus the greater the immiscible fingering (27). The distribution of the fingering effects in porous media has been reported to be a function of the density, viscosity, surface tension (27) and the displacement velocity

(13) of the fluids involved as well as the porous media heterogeneity (28).

Wettability

Wettability refers to the relative affinity of the soil for the various fluids - water, air, and the organic phase. On a solid surface, exposed to two different fluids, the wettability can be inferred from the contact angle (66), also referred to as the wetting angle, refer to Figure 15. In general, if the wetting angle is less than 90 degrees, the fluid is said to be the wetting fluid. In this scenario, water will preferentially occupy the smaller pores and will be found on solid surfaces (14). When the wetting angle is near 90 degrees, neither fluid is preferentially attracted to the solid surfaces. If the wetting angle is greater than 90 degrees, the DNAPL is said to be the wetting fluid. The wetting angle is an indicator used to determine whether the porous material will be preferentially wetted by either the hydrocarbon or the aqueous phase (71). Wettability, therefore, describes the preferential spreading of one fluid over solid surfaces in a two-fluid system. The wetting angle, which is a measure of wettability, is a solid-liquid interaction and can actually be defined in terms of interfacial tensions (71). Several methods have been developed to measure the wetting angle (36,71). In most natural systems, water is the wetting fluid, and the immiscible fluid is the non-wetting fluid. Coal tar may be the exception (i.e. contact angle greater than 90 degrees), which is mainly attributed to the presence of surfactants (70). The wetting fluid will tend to coat the surface of grains and occupy smaller spaces (i.e. pore throats) in porous media, the non-wetting fluid will tend to be restricted to the largest openings (47).

The wetting angle depends on the character of the solid surface on which the test is conducted. The test is conducted on flat plates composed of minerals which are believed representative of the media, or on glass. Contact angle measurements for crude oil indicates that the wetting angles vary widely depending on the mineral surface (53). Soil and aquifer material are not composed of homogeneous mineral composition nor flat surfaces. The measured wetting angle can only be viewed as a qualitative indicator of wetting behavior.

The reader is recommended to refer to reference No. 82 for review of the basic principles and for various techniques to measure the following DNAPL parameters: density, viscosity, interfacial tension, solubility, vapor pressure, and volatility.

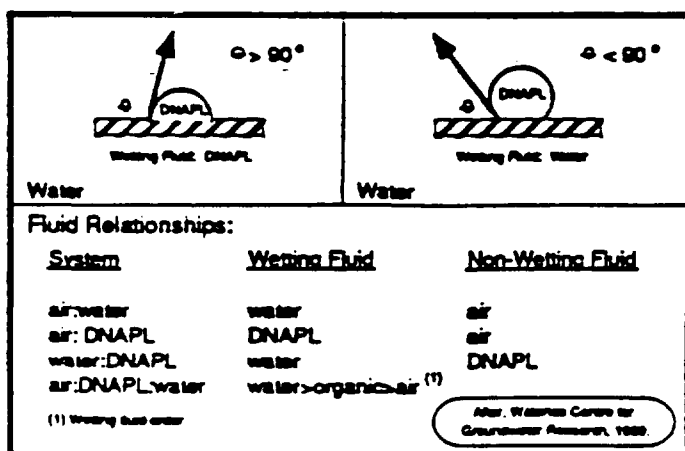


Figure 15. Wetting angle and typical wetting fluid relationships.

Subsurface Media Characteristics

Capillary Force/Pressure

Capillary pressure is important in DNAPL transport because it largely determines the magnitude of the residual saturation that is left behind after a spill incident. The greater the capillary pressure, the greater the potential for residual saturation. In general, the capillary force increases in the following order; sand, silt, clay. Correspondingly, the residual saturation increases in the same order. Capillary pressure is a measure of the tendency of a porous medium to suck in the wetting fluid phase or to repel the nonwetting phase (2). Capillary forces are closely related to the wettability of the porous media. The preferential attraction of the wetting fluid to the solid surfaces cause that fluid to be drawn into the porous media. Capillary forces are due to both adhesion forces (the attractive force of liquid for the solids on the walls of the channels through which it moves) and cohesion forces (the attraction forces between the molecules of the liquid) (32). The capillary pressure depends on the geometry of the void space, the nature of solids and liquids, the degree of saturation (2) and in general, increases with a decrease in the wetting angle and in pore size, and with an increase in the interfacial tension (71). All pores have some value of capillary pressure. Before a nonwetting fluid can enter porous media, the capillary pressure of the largest pores (smallest capillary pressure) must be exceeded. This minimum capillary pressure is called the entry pressure.

In the unsaturated zone, pore space may be occupied by water, air (vapors), or immiscible hydrocarbon. In this scenario, capillary pressure retains the water (wetting phase) mainly in the smaller pores where the capillary pressure is greatest. This restricts the migration of the DNAPL (non-wetting phase) through the larger pores unoccupied by water. Typically, DNAPL does not displace the pore water from the smaller pores. It is interesting to note that the migration of DNAPL through fine material (high capillary pressure) will be impeded upon reaching coarser material (low capillary pressure).

The capillary fringe will obstruct the entry of the DNAPL into the saturated zone. When a sufficient volume of DNAPL has been released and the "DNAPL pressure head" exceeds the water capillary pressure at the capillary fringe (entry pressure), the DNAPL will penetrate the water table. This is why DNAPL is sometimes observed to temporarily flatten out on top of the water table. Similarly, laboratory experiments have been conducted in which DNAPL (tetrachloroethylene) infiltrating through porous media was found to flow laterally and cascade off lenses too fine to penetrate (28), (refer to Figure 11). This was attributed to the inability of the DNAPL to overcome the high capillary pressure associated with the lenses. Logically, when "DNAPL pressure head" exceeds the capillary pressure, the DNAPL will penetrate into the smaller pores. These laboratory experiments are important because they illustrate that small differences in the capillary characteristics of porous media can induce significant lateral flow of non-wetting fluids.

A comprehensive investigation of capillary trapping and multiphase flow of organic liquids in unconsolidated porous media revealed many intricacies of this process in the vadose and saturated zone (66). An important note is that while capillary pressure is rarely measured at hazardous waste sites,

the soil texture (sand, silt, clay) is usually recorded during drilling operations and soil surveys. This information, along with soil core analyses will help to delineate the stratigraphy and the volume distribution of NAPL.

Pore Size Distribution/Initial Moisture Content

In natural porous media, the geometry of the pore space is extremely irregular and complex (2). The heterogeneity of the subsurface environment i.e. the variability of the pore size distribution, directly affects the distribution of the capillary pressures along the interfaces between the aqueous and immiscible phases (50). In saturated column experiments, it was observed that NAPL preferentially traveled through strings of macropores, almost completely by-passing the water filled micropores (66). In the same study, a heterogeneous distribution of coarse and fine porous material was simulated. Most of the incoming organic liquid preferentially traveled through the coarse lens material.

In short term column drainage experiments, results indicated that the particle grain size is of primary importance in controlling the residual saturation of a gasoline hydrocarbon (19). Fine and coarse sands (dry) were found to have 55% and 14% residual saturation, respectively. The finer the sand, the greater the residual saturation. During these experiments, the residual saturation was reduced 20-30% in a medium sand and 60% in a fine sand when the sands were initially wet. Soil pore water held tightly by capillary forces in the small pores will limit the NAPL to the larger pores, and thus, result in lower residual saturation. In a similar laboratory (unsaturated) column study, the smaller the grain size used in the experiment, the greater the residual saturation of the NAPL (74). The residual saturation in the saturated column experiments was found to be greater than the unsaturated columns and was independent of the particle size distribution.

These observations follow traditional capillary force theory. Residual saturation resulting from a DNAPL spill in the saturated zone is highly dependent on the antecedent moisture content in the porous media. When the moisture content is low, the strong capillary forces in the smaller pores tenaciously draw in and hold the DNAPL. When the moisture content is high, the capillary forces in the smaller pores will retain the soil pore water, and DNAPL residual saturation will mainly occur in the larger pores. Therefore, greater residual saturation can be expected in dryer soils. Correspondingly, NAPL will migrate further in a wetter soil, and displacement of NAPL from small pores is expected to be more difficult than from large pores.

Stratigraphic Gradient

DNAPL migrating vertically will likely encounter a zone or stratigraphic unit of lower vertical permeability. A reduction in the vertical permeability of the porous media will induce lateral flow of the DNAPL. The gradient of the lower permeable stratigraphic unit will largely determine the direction in which the DNAPL will flow. This is applicable to both the saturated and unsaturated zones. As depicted in Figures 13a and 13b, the lateral direction of DNAPL flow may be in a different direction than ground-water flow.

Ground Water Flow Velocity

The ground water flow velocity is a dynamic stress parameter which tends to mobilize the hydrocarbon (39). As the ground water velocity increases, the dynamic pressure and viscous forces increase. Mobilization of DNAPL occurs when the viscous forces of the ground water acting on the DNAPL exceeds the porous media capillary forces retaining the DNAPL.

Saturation Dependent Functions

Residual Saturation

Residual saturation is defined as the volume of hydrocarbon trapped in the pores relative to the total volume of pores (38) and therefore is measured as such (74). Residual saturation has also been described as the saturation at which NAPL becomes discontinuous and is immobilized by capillary forces (36). The values of residual saturation vary from as low as 0.75 - 1.25% for light oil in highly permeable media to as much as 20% for heavy oil (50). Residual saturation values have also been reported to range from 10% to 50% of the total pore space (39,74). Other researchers reported that residual saturation values appear to be relatively insensitive to fluid properties and very sensitive to soil properties (and heterogeneities) (66). Laboratory studies conducted to predict the residual saturation in soils with similar texture and grain size distribution yielded significantly different values. It was concluded that minor amounts of clay or silt in a soil may play a significant role in the observed values.

In the unsaturated zone during low moisture conditions, the DNAPL residual saturation will wet the grains in a pendular state (a ring of liquid wrapped around the contact point of a pair of adjacent grains). During high moisture conditions, the wetting fluid, which is typically water, will preferentially occupy the pendular area of adjacent grains and the hydrocarbon will occupy other available pore space, possibly as isolated droplets. In the saturated zone, the DNAPL residual saturation will be present as isolated drops in the open pores (47). Furthermore, results of laboratory experimentation indicated that residual saturation increased with decreasing hydraulic conductivity in both the saturated and unsaturated zones and that the residual saturation is greatest in the saturated zone. Laboratory experiments indicated that vadose zone residual saturation was roughly one third of the residual saturation in the saturated zone (66). The increase in residual saturation in the saturated zone is due to the following: [1] the fluid density ratio (DNAPL:air versus DNAPL:water above and below the water table, respectively) favors greater drainage in the vadose zone; [2] as the non-wetting fluid in most saturated media, NAPL is trapped in the larger pores; and, [3] as the wetting fluid in the vadose zone, NAPL tends to spread into adjacent pores and leave a lower residual content behind, a process that is inhibited in the saturated zone (36). Thus, the capacity for retention of DNAPLs in the unsaturated zone is less than the saturated zone.

Relative Permeability

Relative permeability is defined as the ratio of the permeability of a fluid at a given saturation to its permeability at 100% saturation. Thus it can have a value between 0 and 1 (71).

Figure 16 illustrates a relative permeability graph for a two fluid phase system showing the relationship between the observed permeability of each fluid for various saturations to that of the observed permeability if the sample were 100% saturated with that fluid (73). The three regions of this graph are explained as follows (71): Region I has a high saturation of DNAPL and is considered a continuous phase while the water is a discontinuous phase, therefore, water permeability is low. Assuming the DNAPL is the non-wetting fluid, water would fill the smaller capillaries and flow through small irregular pores. In Region II, both water and DNAPL are continuous phases although not necessarily in the same pores. Both water and

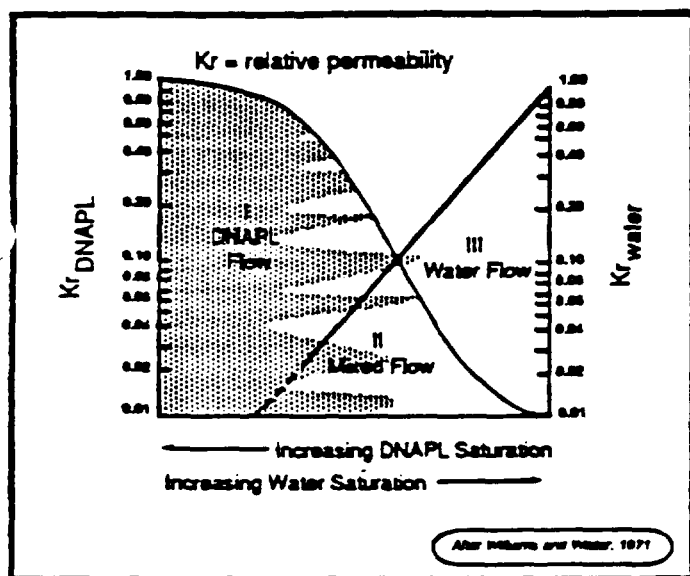


Figure 16. Relative permeability graph.

- NAPL flow simultaneously. However, as saturation of either phase increases, the relative permeability of the other phase correspondingly decreases. Region III exhibits a high saturation of water while the DNAPL phase is mainly discontinuous. Water flow dominates this region and there is little or no flow of DNAPL.
- Both fluids flow through only a part of the pore space and thus only a part of the cross section under consideration is available for flow of each fluid. Therefore, the discharge of each fluid must be lower corresponding to its proportion of the cross sectional area (46).
- Figure 17 is another relative permeability graph which demonstrates several points. Small increases in DNAPL saturation results in a significant reduction in the relative permeability of water. However, a small increase in water saturation does not result in a significant reduction in DNAPL relative permeability. This figure identifies two points, SO1 and SO2, where the saturation of the DNAPL and the water are greater than 0 before there is a relative permeability for this fluid. The two fluids hinder the movement of the other to different degrees and both must reach a minimum saturation before they achieve any mobility at all (47). These minimum saturations, for the water and DNAPL, are identified as irreducible and residual saturation, respectively.

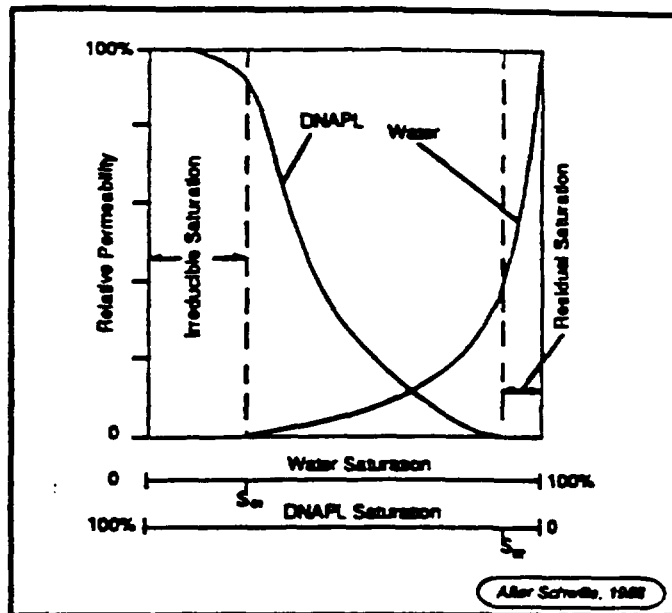


Figure 17. The relative permeability curves for water and a DNAPL in a porous medium as a function of the pore space saturation.

Site Characterization for DNAPL

Characterization of the subsurface environment at hazardous waste sites containing DNAPL is complex and will likely be expensive. Specific details associated with the volume and timing of the DNAPL release are usually poorer or not available and subsurface heterogeneity is responsible for the complicated and unpredictable migration pathway of subsurface DNAPL transport. As discussed previously, slight changes in vertical permeability may induce a significant horizontal component to DNAPL migration.

Site characterization typically involves a significant investment in ground-water analyses. Although analysis of ground water provides useful information on the distribution of the soluble components of the DNAPL, the presence of other phases of the DNAPL may go unrecognized. The investigation must, therefore, be more detailed to obtain information concerning the phase distribution of the DNAPL at a site. Site characterization may require analyses on all four phases (aqueous, gaseous, solid, immiscible) to yield the appropriate information (refer to Table 2). In brief, data collected on the various phases must be compiled, evaluated and used to help identify: where the contaminant is presently located; where it has been; what phases it occurs in; and what direction the mobile phases may be going. A comprehensive review of site characterization for subsurface investigations is available (68). Development of monitoring and remediation strategies can be focused more effectively and efficiently after a clear definition of the phase distribution has been completed.

Ground Water

Ground water analyses for organic compounds, in conjunction with ground water flow direction data, has repeatedly been used to: delineate the extent of ground water contamination from DNAPL; determine the direction of plume migration; and

Table 2 - Phase Distribution of DNAPL in the Subsurface

MATRIX	PHASE
1. ground water	aqueous - soluble components of DNAPL
2. soil/aquifer material	solid - adsorbed components of DNAPL on solid phase material
3. DNAPL	immiscible - continuous phase (mobile), residual saturation (immobile)
4. soil gas	gaseous - volatile components

to identify probable DNAPL source area(s). While this approach has been used successfully to characterize the distribution of contaminants in the subsurface, there are limitations. For example, since DNAPL and ground water may flow in different directions, as indicated in Figures 13a and 13b, ground water analyses may not necessarily identify the direction of DNAPL migration.

Ground water analyses may be useful to identify probable DNAPL source areas, but, estimating the volume of DNAPL in the subsurface is limited using this approach. Soluble phase components of DNAPL are rarely found in excess of 10% of the solubility even when organic liquids are known or suspected to be present. The concentration of soluble DNAPL components in the ground water is not only a function of the amount of DNAPL present, but also the chemical and physical characteristics of the DNAPL, the contact area and time between the ground water and DNAPL, and numerous transport and fate parameters (retardation, biodegradation, dispersion, etc.). One technique has been developed using chemical ratios in the ground water as a means of source identification and contaminant fate prediction (18).

Soil/Aquifer Material

Exploratory Borings

Physical and chemical analyses of soil and aquifer material (drill cuttings, cores) from exploratory borings will provide useful information in the delineation of the horizontal and vertical mass distribution of DNAPL. While simple visual examination for physical presence or absence of contamination might seem like a worthwhile technique, it can be deceiving and does nothing to sort out the various liquid phases and their relationship to each other (71). A quantitative approach is necessary to determine DNAPL distribution.

Drill cuttings or core material brought to the surface from exploratory borings can be screened initially to help delineate the depth at which volatile components from the various phases of the hydrocarbon exists. The organic vapor analyzer and the HNU are small portable instruments that can detect certain volatile compounds in the air. These methods are used to initially screen subsurface materials for volatile components of DNAPL. Identification of individual compounds and their concentrations may be confirmed by other, more precise, analyses.

Analysis of the soil or aquifer material by more accurate means, such as gas chromatography or high pressure liquid chromatography, will take longer but will provide more specific information on a larger group of organic compounds, i.e., volatile/non-volatile, and on specific compounds. This information is necessary to help fix the horizontal and vertical mass distribution of the contaminant and to help delineate the phase distribution. These analyses do not distinguish between soluble, sorbed or free-phase hydrocarbon, however, a low relative concentration indicates that the contaminant may mainly be present in the gaseous or aqueous phases; and a high relative concentration indicates the presence of sorbed contaminant or free phase liquid either as continuous-phase or residual saturation. A more rigorous set of analyses is required to distinguish between the various phases.

Additional tests to identify the presence of NAPL in soil or aquifer core sample are currently undeveloped and research in this area is warranted. Squeezing and immiscible displacement techniques have been used to obtain the pore water from cores (40). Other methods of phase separation involving vacuum or centrifugation may also be developed for this use. A paint filter test was proposed in one Superfund DNAPL field investigation where aquifer cores were placed in a filter/funnel apparatus, water was added, and the filtrate was examined for separate phases. These core analysis techniques have potential to provide valuable field data to characterize NAPL distribution.

Cone Penetrometer

The cone penetrometer (ASTM D3441-86)(69) has been used for some time to supply data on the engineering properties of soils. Recently, the application of this technology has made the leap to the hazardous waste arena. The resistance of the formation is measured by the cone penetrometer as it is driven vertically into the subsurface. The resistance is interpreted as a measure of pore pressure, and thus provides information on the relative stratigraphic nature of the subsurface. Petroleum and chlorinated hydrocarbon plumes can be detected most effectively when the cone penetrometer is used in conjunction with in-situ sensing technologies (48). Features of the cone penetrometer include: a continuous reading of the stratigraphy/permeability; in-situ measurement; immediate results are available; time requirements are minimal; vertical accuracy of stratigraphic composition is high; ground-water samples can be collected in-situ; and the cost is relatively low.

Data from the cone penetrometer can be used to delineate probable pathways of DNAPL transport. This is accomplished by identifying permeability profiles in the subsurface. A zone of low permeability underlying a more permeable stratigraphic unit will likely impede vertical transport of the DNAPL. Where such a scenario is found, a collection of DNAPL is probable and further steps can be implemented to more accurately and economically investigate and confirm such an occurrence. This general approach has successfully been implemented at one Superfund site (8).

DNAPL

Well Level Measurements

In an effort to delineate the horizontal and vertical extent of the DNAPL at a spill site, it is important to determine the elevation

of DNAPL in the subsurface. Monitoring DNAPL elevation over time will indicate the mobility of the DNAPL. There are several methods that can be used to determine the presence of DNAPL in a monitoring well. One method relies on the difference in electrical conductivity between the DNAPL and water. A conductivity or resistivity sensor is lowered into the well and a profile is measured. The interface of the DNAPL is accurately determined when the difference in conductivity is detected between the two fluids. This instrument may also be used to delineate LNAPL. A transparent, bottom-loading bailer can also be used to measure the thickness (and to sample) of DNAPL in a well (36). The transparent bailer is raised to the surface and the thickness of the DNAPL is made by visual measurement.

Several laboratory and field studies have been performed which investigate the anomaly between the actual and measured LNAPL levels in ground-water wells (15,16,24,25). The anomaly between actual and measured NAPL thickness in the subsurface is also applicable to DNAPL, but for different reasons. The location of the screening interval is the key to understanding both scenarios. First, if the well screen interval is situated entirely in the DNAPL layer, and the hydrostatic head (water) in the well is reduced by pumping or bailing, then to maintain hydrostatic equilibrium, the DNAPL will rise in the well (36,44,71) (refer to Figure 18). Secondly, if the well screen extends into the barrier layer, the DNAPL measured thickness will exceed that in the formation by the length of the well below the barrier surface (36) (refer to Figure 19). Both of these scenarios will result in a greater DNAPL thickness in the well and thus a false indication (overestimate) of the actual DNAPL thickness will result. One of the main purposes of the monitoring well in a DNAPL investigation is to provide information on the thickness of the DNAPL in the aquifer. Therefore, construction of the well screen should intercept the ground water:DNAPL interface and the lower end of the screen should be placed as close as possible to the impermeable stratigraphic unit.

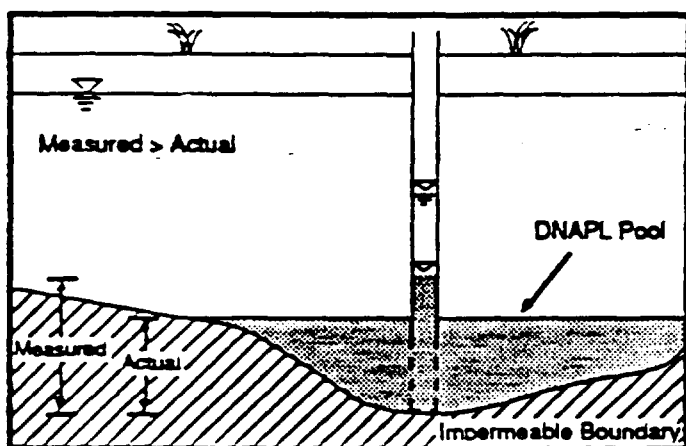


Figure 18. A well screened only in the DNAPL in conjunction with lower hydrostatic head (i.e. water) in the well may result in an overestimation of DNAPL thickness.

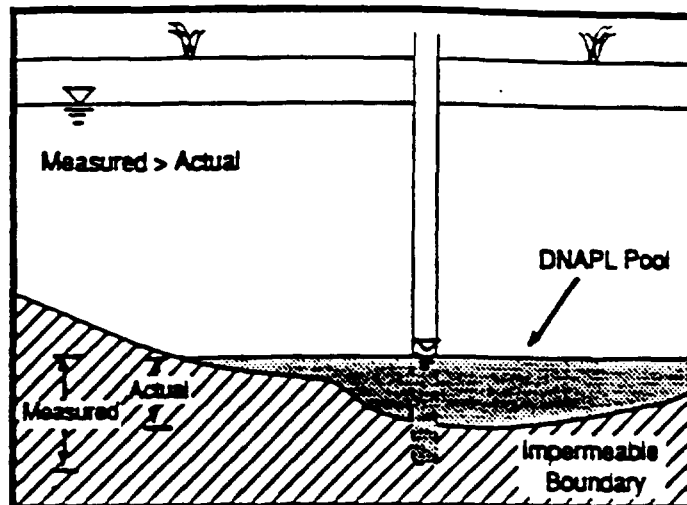


Figure 19. A well screened into an impermeable boundary may result in an over-estimation of the DNAPL thickness.

DNAPL Sampling

Sampling of DNAPL from a well is necessary to perform chemical and physical analyses on the sample. Two of the most common methods used to retrieve a DNAPL sample from a monitoring well are the peristaltic pump and the bailer. A peristaltic pump can be used to collect a sample if the DNAPL is not beyond the effective reach of the pump, which is typically less than 25 feet. The best method to sample DNAPL is to use a double check valve bailer. The key to sample collection is controlled, slow lowering (and raising) of the bailer to the bottom of the well (57). The dense phase should be collected prior to purging activities.

Soil-Gas Surveys

A soil-gas survey refers to the analysis of the soil air phase as a means to delineate underground contamination from volatile organic chemicals and several techniques have been developed (34,52). This investigative tool is mainly used as a preliminary screening procedure to delineate the areal extent of volatile organic compounds in the soil and ground water. This method is quick, less expensive than drilling wells and can provide greater plume resolution (33).

Data from a soil-gas survey is a valuable aid in the development of a more detailed subsurface investigation where ground water monitoring wells and exploratory borings are strategically located for further site characterization. There are limitations to soil-gas surveys (26,52) and data interpretation must be performed carefully (35,49). Soil-gas investigations have mainly been conducted to identify the location of the organic contaminants in ground water. At the time of this publication, the scientific literature did not contain information specifically applicable to the delineation of DNAPL from soil-gas survey data. However, it is surmisable that soil-gas surveys can be used to help delineate DNAPL residual saturation in the unsaturated zone or the location of perched DNAPL reservoirs.

Miscellaneous

The vertical migration of DNAPL in the saturated zone will eventually be challenged by a low permeability stratigraphic unit. According to the principles of capillary pressure, the lower permeability unit will exhibit a greater capillary pressure. Displacement of water by DNAPL requires that the hydrostatic force from the mounding DNAPL exceed the capillary force of the low permeability unit. The Hobson formula is used to compute the critical height calculation to overcome the capillary pressure under different pore size conditions (70).

In an effort to minimize further DNAPL contamination as a result of drilling investigations, precautionary steps should be taken. Penetration of DNAPL reservoirs in the subsurface during drilling activities offers a conduit for the DNAPL to migrate vertically into previously uncontaminated areas. It is very easy to unknowingly drill through a DNAPL pool and the bed it sits on, causing the pool to drain down the hole into a deeper part of the aquifer or into a different aquifer (32). Special attention to grouting and sealing details during and after drilling operations will help prevent cross-contamination.

Precautionary efforts should also be considered when a DNAPL reservoir is encountered during drilling operations. The recommended approach is to cease drilling operations and install a well screen over the DNAPL zone and cease further drilling activities in the well. If it is necessary to drill deeper, construction of an adjacent well is recommended. Alternatively, if it is not necessary to screen off that interval, it is recommended to carefully seal off the DNAPL zone prior to drilling deeper.

Well construction material compatibility with DNAPL should be investigated to minimize downhole material failure. A construction material compatibility review and possible testing will prevent the costly failure of well construction material. The manufacturers of well construction material are likely to have the most extensive compatibility data and information available.

Remediation

Remediation of DNAPL mainly involves physical removal by either pumping or trench-drainline systems. Removal of DNAPL early in the remediation process will eliminate the main source of contaminants. This step will substantially improve the overall recovery efficiency of the various DNAPL phases including the long term pump and treat remediation efforts for soluble components. Remediation technologies such as vacuum extraction, biodegradation, ground water pumping, and soil flushing is mainly directed at the immobile DNAPL and the various phases in which its components occur. Physical barriers can be used in an effort to minimize further migration of the DNAPL.

Clean-up of DNAPL can involve sizable expenditures; they are difficult to extract and the technology for their removal is just evolving (43). Historically, field recovery efforts usually proceed with a poor understanding of the volume distribution of the DNAPL. This reflects the difficulties involved in adequate site characterization, poor documentation of the release, and the complexity associated with the DNAPL transport in the subsurface.

Pumping Systems

Pumping represents an important measure to stop the mobile DNAPL from migrating as a separate phase by creating a hydraulic containment and by removal of DNAPL (44). Very simply, DNAPL recovery is highly dependent on whether the DNAPL can be located in the subsurface. The best recovery scenario is one in which the DNAPL is continuous and has collected as a reservoir in a shallow, impermeable subsurface depression. Once the DNAPL has been located and recovery wells are properly installed, pumping of pure phase DNAPL is a possible option but depends largely on site specific conditions which include, but are not limited to: DNAPL thickness, viscosity, and permeability.

Many DNAPL reservoirs in the subsurface are of limited volume and areal extent. Therefore, it can be expected that both the level of DNAPL (saturated thickness) in the well will decline from the prepumping position and the percentage of DNAPL in the DNAPL/water mixture will decrease rather rapidly. Correspondingly, DNAPL recovery efficiency decreases. Field results indicate that recovery wells screened only in the DNAPL layer will maintain maximum DNAPL/water ratios (102). Well diameter was not found to influence long term DNAPL recovery; however, large diameter wells allow high volume pumping for short durations; and small diameter wells result in lower DNAPL/water mixtures and greater drawdown.

An enhanced DNAPL recovery scheme may be used to improve recovery efficiency. An additional well is constructed with a screen interval in the ground water zone located vertically upward from the DNAPL screen intake. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL (70), refer to Figure 20. The upwelling of the DNAPL, coal tar in this case, improved the rate (twofold) at which the coal tar was recovered resulting in a more efficient operation. The ground water withdrawal rate must be carefully determined; too much will result in the coal tar from rising excessively and being either mixed (emulsions) with or suppressed by the higher water velocity above; too low will not

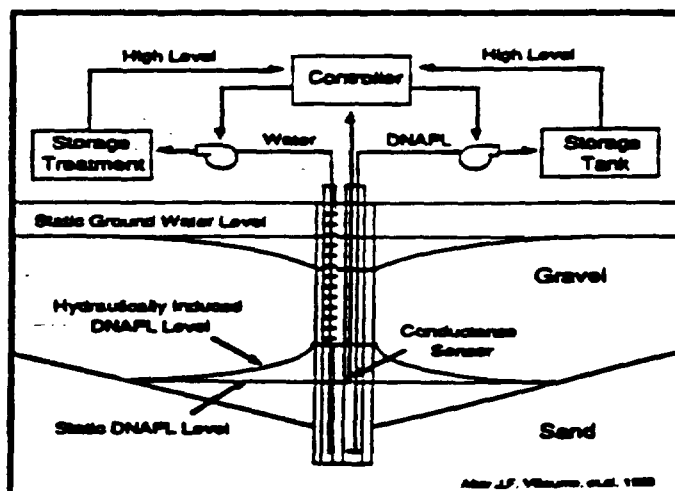


Figure 20. A DNAPL recovery system where deliberate upwelling of the static coal-tar surface is used to increase the flow of product into the recovery wells.

caused upwelling. An estimate of this upwelling can be calculated using the simplified Ghyben-Herzberg Principle under ideal conditions (4). Laboratory studies indicated that dimethyl phthalate (1.19 g/cc) recovery rate was doubled or tripled over the conventional, non-upconing, recovery scheme (75). A similar application of this technique was used to increase the level of DNAPL (solvents) in a sandstone bedrock formation (11). Other enhanced DNAPL recovery techniques were implemented utilizing both water flooding and wellbore vacuum. Essentially, this minimized drawdown, allowing a maximum pumping rate of the DNAPL/water mixture. Both techniques offered significant advantages in terms of the rate and potential degree of DNAPL removal (8).

The highly corrosive nature of some DNAPL's may increase maintenance problems associated with the recovery system. A design consideration during any DNAPL recovery program should include a material compatibility review to minimize downhole failures. This is applicable to the well construction material and the various appurtenances of the recovery system. Manufacturers of the construction material would most likely have the best compatibility information available.

While most scientists agree that the residual saturation of immiscible hydrocarbon droplets in porous media are immobile, researchers have investigated the mobility of residual saturation in porous media for enhanced oil recovery and for NAPL remediation at spill sites. Specifically, this includes a complex interplay between four forces (viscous, gravity, capillary, buoyancy). These forces are dependent on both the chemical and physical characteristics of the DNAPL and porous media. The mobilization of residual saturation mainly hinges on either increasing the ground water velocity which increases the viscous forces between the residual saturation and the ground water, or decreasing the interfacial tension between the residual saturation and the ground water which decreases the capillary forces.

The capillary number is an empirical relationship which measures the ratio between the controlling dynamic stresses (absolute viscosity and ground water velocity) and static stresses (interfacial tension) of the residual saturation (39). The former are the viscous stresses and the dynamic pressure in the water which tend to move the oil. The latter are the capillary stresses in the curved water/oil interfaces which tend to hold the oil in place. As the capillary number is increased, the mobility of the residual saturation increases. In a laboratory column study, the capillary number had to be increased two orders of magnitude from when motion was initiated to complete displacement of the hydrocarbon in a sandstone core (74). In a glass bead packed column, only one order of magnitude increase was required. However, a higher capillary number was required to initiate mobility. The difference in mobility between the two columns was attributed to the pore geometry, i.e. size, shape.

There are limitations to residual saturation mobilization. The ground water gradient (dh/dl) necessary to obtain the critical capillary number to initiate blob mobilization would be 0.24. To obtain complete NAPL removal would require a gradient of 18 (3). Ground water gradients of this magnitude are unrealistic. Another estimate of the gradient necessary to mobilize carbon tetrachloride in a fine gravel and medium sand was 0.09 and 9.0 respectively (74). The former gradient is steep but not unreasonable and the latter gradient is very steep and

impractical to achieve in the field. The same researchers concluded from more recent, comprehensive studies, that the earlier predictions were optimistic, and that the gradient necessary to mobilize residual organic liquid is clearly impractical (66). Another limitation is that along with residual saturation mobilization, the NAPL blobs disperse into smaller blobs and that the blob distribution was dependent on the resulting capillary number (6). Recovery of the NAPL residual saturation by pumping ground water may be more feasible where the porous media is coarse and capillary forces are low, i.e. coarse sands and gravel. However, even in this scenario, it is expected that the radius of residual saturation mobilization would be narrow.

It is held in petroleum engineering theory that the only practical means of raising the capillary number dramatically is by lowering the interfacial tension (39) and that this can be achieved by using surfactants (66). Surfactants reduce the interfacial tension between two liquids, and therefore, are injected into the subsurface for enhanced recovery of immiscible hydrocarbons. In laboratory experiments, surfactant flushing solutions produced dramatic gains in flushing even after substantial water flushing had taken place (54). Unfortunately, surfactants can be quite expensive and cost prohibitive in NAPL recovery operations. Surfactants are usually polymeric in nature and a surfactant residue may be left behind in the porous media which may not be environmentally acceptable. Additionally, surfactants may be alkaline and thus affect the pH of the subsurface environment. It has been suggested that such a surfactant may inhibit bacterial metabolism and thus preclude subsequent use of biological technologies at the site. Significant research in this area is currently underway which may uncover information improving the economics and feasibility of this promising technology.

In summary, practical considerations and recommendations concerning the mobilization and recovery of residual saturation include the following: greater effectiveness in very coarse porous media i.e. coarse sands and gravel; recovery wells should be installed close to the source to minimize flow path distance; a large volume of water will require treatment/disposal at the surface; compounds with high interfacial tension or viscosity will be difficult to mobilize; and implementation of linear one-dimensional sweeps through the zones of residual saturation (74) and surfactants will optimize recovery.

Pumping the soluble components (aqueous phase) of DNAPL from the immiscible (continuous and residual saturation), solid (sorbed), and gaseous phases has been perhaps one of the most effective means to date to both recover DNAPL from the subsurface and to prevent plume migration. Recovery of soluble components quite often has been the only remediation means available. This is largely attributed to the inability to locate DNAPL pools and due to low, DNAPL yielding formations. The basic principles and theory of pump and treat technology and the successes and failures have been summarized in other publications (64,67) and is beyond the scope of this publication.

Pumping solubilized DNAPL components from fractured rock aquifers historically has been plagued with a poor recovery efficiency. Although the rock matrix has a relatively small intergranular porosity, it is commonly large enough to allow dissolved contaminants from the fractures to enter the matrix

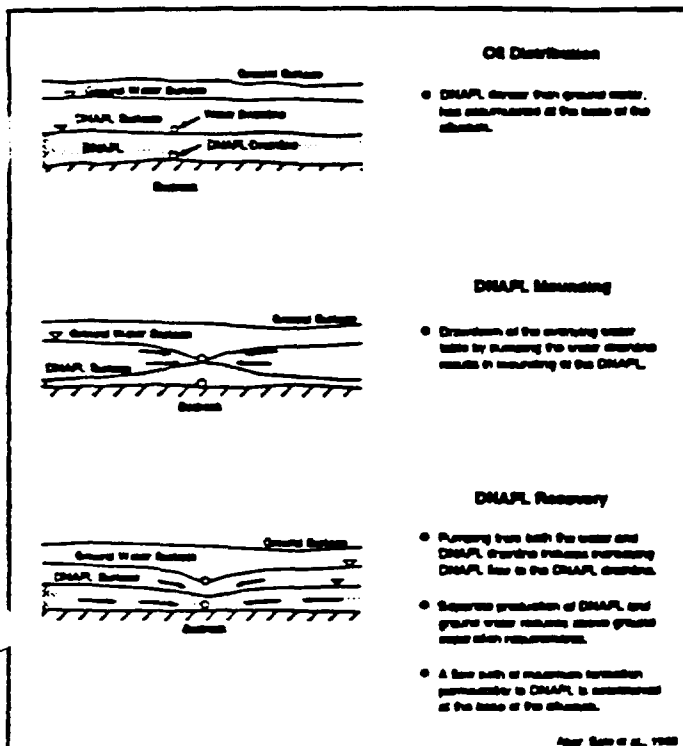


Figure 21. Trench recovery system of DNAPL utilizing the dual drainline concept.

by diffusion and be stored there by adsorption (32). The release of these components is expected to be a slow diffusion dominated process. This is because little or no water flushes through dead-end fracture segments or through the porous, impervious rock matrix. Therefore, clean-up potential is estimated to be less than that expected for sand and gravel aquifers.

Trench Systems

Trench systems have also been used successfully to recover DNAPL and are used when the reservoir is located near the ground surface. Trench systems are also effective when the DNAPL is of limited thickness. Recovery lines are placed horizontally on top of the impermeable stratigraphic unit. DNAPL flows into the collection trenches and seep into the recovery lines. The lines usually drain to a collection sump where the DNAPL is pumped to the surface. Similar to the pumping system, an enhanced DNAPL recovery scheme may be implemented using drain lines to improve recovery efficiency. This "dual drain line system" (41) utilizes a drain line located in the ground water vertically upward from the DNAPL line. Ground water is withdrawn from the upper screen which results in an upwelling of the DNAPL which is collected in the lower line, refer to Figure 21. This increases the hydrostatic head of the DNAPL. Excessive pumping of either single or dual drain line systems may result in the ground water "pinching off" the flow of DNAPL to the drain line. An advantage of the dual drain system is that the oil:water separation requirements at the surface are reduced.

Vacuum Extraction

Soil vacuum extraction (SVE) is a remediation technology which involves applying a vacuum to unsaturated subsurface strata to induce air flow. Figure 22 illustrates that the volatile contaminants present in the contaminated strata will evaporate and the vapors are recovered at the surface and treated. Common methods of treatment include granular activated carbon, catalytic oxidation, and direct combustion. SVE can effectively remove DNAPL present as residual saturation or its soluble phase components in the unsaturated zone. In general, vacuum extraction is expected to be more applicable for the chlorinated solvents (PCE, TCE, DCE) than the polycyclic aromatic compounds (wood preserving wastes, coal tars, etc.). When DNAPL is present in perched pools (Figure 12) it is more effective to remove the continuous phase DNAPL prior to the implementation of SVE. The same strategy is applicable in the saturated zone where DNAPL removal by SVE is attempted concomitantly with lowering the water table. Upon lowering the water table, SVE can be used to remove the remnant volatile wastes not previously recovered. Often, the precise location of the DNAPL is unknown; therefore, SVE can be used to remediate the general areas where the presence of DNAPL is suspected. Removal of DNAPL by SVE is not expected to be as rapid as direct removal of the pure phase compound. One advantage of SVE however, is that the precise location of the DNAPL need not be known.

Important parameters influencing the efficacy of SVE concern both the DNAPL and porous media. Porous media specific parameters include: soil permeability, porosity, organic carbon, moisture, structure, and particle size distribution. DNAPL specific parameters include: vapor pressure, Henry's constant, solubility, adsorption equilibrium, density, and viscosity (20). These parameters and their relationships must be evaluated on a site specific basis when considering the feasibility of vacuum extraction and a practical approach to the design, construction, and operation of venting systems (22). Additionally, soil gas surveys which delineate vapor concentration as a function of depth is critical in locating the contaminant source and designing an SVE system.

Historically, SVE has been used to remove volatile compounds from the soil. Recently it has been observed that SVE enhances the biodegradation of volatile and semivolatile organic compounds in the subsurface. While SVE removes volatile components from the subsurface, it also aids in supplying oxygen to biological degradation processes in the unsaturated zone. Prior to soil venting, it was believed that biodegradation in the unsaturated zone was limited due to inadequate concentrations of oxygen (17). In a field study where soil venting was used to recover jet fuel, it was observed that approximately 15% of the contaminant removal was from the result of microbial degradation. Enhanced aerobic biodegradation during SVE increases the cost effectiveness of the technology due to the reduction in the required above ground treatment.

Vacuum extraction is one form of pump and treat which occurs in the saturated zone where the fluid is a gas mixture. Therefore, many of the same limitations to ground water pump and treat are also applicable to vacuum extraction. While the application of vacuum extraction is conceptually simple, its success depends on understanding complex subsurface

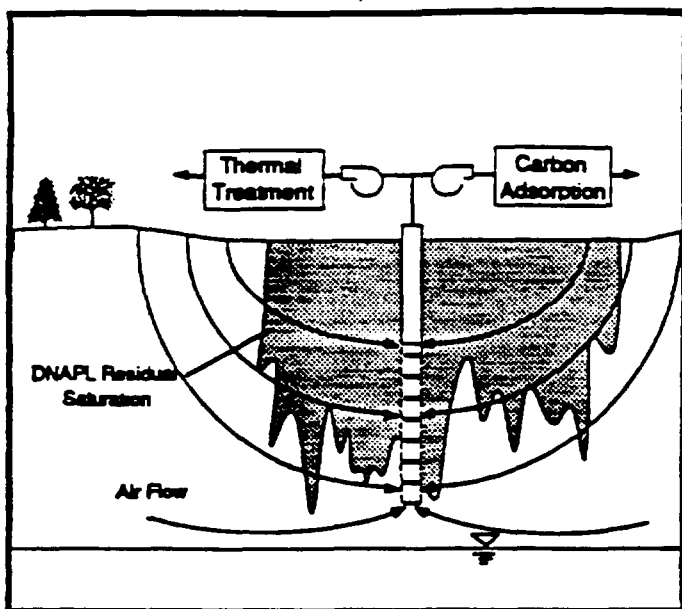


Figure 22. Vacuum extraction of DNAPL volatile components in the unsaturated zone. As shown here, vapors are treated by thermal combustion or carbon adsorption and the air is discharged to the atmosphere.

chemical, physical, and biological processes which provide insight into factors limiting its performance (9).

Biodegradation

The potential for biodegradation of immiscible hydrocarbon is highly limited for several reasons. First, pure phase hydrocarbon liquid is a highly hostile environment to the survival of most microorganisms. Secondly, the basic requirements for microbiological proliferation (nutrients, electron acceptor, pH, moisture, osmotic potential, etc.) is difficult if not impossible to deliver or maintain in the DNAPL. A major limitation to aerobic bioremediation of high concentrations of hydrocarbon is the inability to deliver sufficient oxygen. A feasible remediation approach at sites where immiscible hydrocarbon is present is a phased technology approach. Initial efforts should focus on pure phase hydrocarbon recovery to minimize further migration and to decrease the volume of NAPL requiring remediation. Following NAPL recovery, other technologies could be phased into the remediation effort. Bioremediation may be one such technology that could be utilized to further reduce the mass of contaminants at the site. NAPL recovery preceding bioremediation will improve bioremediation feasibility by reducing the toxicity, time, resources, and labor.

Similar to other remediation technologies, a comprehensive feasibility study evaluating the potential effectiveness of bioremediation is critical and must be evaluated on a site specific basis. A comprehensive review of biodegradation of surface soils, ground water, and subsoils of wood preserving wastes, i.e. PAH's (29,37,51,62,63) are available. A comprehensive review of microbial decomposition of chlorinated aromatic compounds is also available (58).

Soil Flushing

Soil flushing utilizing surfactants is a technology that was developed years ago as a method to enhance oil recovery in the petroleum industry. This technology is new to the hazardous waste arena and available information has mainly been generated from laboratory studies. Surfactant soil flushing can proceed on two distinctly different mechanistic levels: enhanced dissolution of adsorbed and dissolved phase contaminants, and displacement of free-phase nonaqueous contaminants. These two mechanisms may occur simultaneously during soil flushing (42).

Surfactants, alkalis, and polymers are chemicals used to modify the pore-level physical forces responsible for immobilizing DNAPL. In brief, surfactants and alkalis reduce the surface tension between the DNAPL and water which increases the mobility. Polymers are added to increase the viscosity of the flushing fluid to minimize the fingering effects and to maintain hydraulic control and improve flushing efficiency. Based on successful laboratory optimization studies where an alkali-polymer-surfactant mixture was used, field studies were conducted on DNAPL (creosote) which resulted in recovery of 94% of the original DNAPL (42). Laboratory research has also been conducted which indicated that aqueous surfactants resulted in orders of magnitude greater removal efficiency of adsorbed and dissolved phase contaminants than water flushing (55).

Depth to contamination, DNAPL distribution, permeability, heterogeneities, soil/water incompatibility, permeability reduction, and chemical retention are important factors when considering soil flushing (42). Prior to this technology being cost effective in the field, surfactant recycling will be necessary to optimize surfactant use (55). Soil flushing is complex from a physical and chemical point of view; is relatively untested in the field; and will likely be challenged regulatorily. Considerable research currently being conducted in this area may result in the increased use of this technology to improve DNAPL recovery in the future.

Thermal methods of soil flushing involve injecting hot water or steam in an effort to mobilize the NAPL. The elevated temperature increases volatilization and solubilization and decreases viscosity and density. A cold-water cap is used to prevent volatilization. The mobile phases of the DNAPL are then recovered using a secondary approach, i.e. pumping, vacuum extraction etc. This approach (Contained Recovery of Oily Wastes) to enhance recovery of DNAPL is currently under EPA's Superfund Innovative Technology Evaluation Program and a pilot-scale demonstration is forthcoming (21). A limitation in the use of thermal methods is that the DNAPL may be converted to LNAPL due to density changes (36). The adverse effects from this are that the DNAPL, existing as a thin layer, becomes buoyant and mobilizes vertically resulting in a wider dispersal of the contaminant. Other limitations involve the high energy costs associated with the elevated water temperature and the heat loss in the formation (36).

Physical Barriers

Physical barriers may be used to prevent the migration of DNAPL's in the subsurface and are typically used in conjunction with other recovery means. One feature of physical

barriers is the hydraulic control it offers providing the opportunity to focus remediation strategies in treatment cells. Unfortunately, physical barriers, while satisfactory in terms of ground water control and containment of dissolved-phase plumes, may contain small gaps or discontinuities which could permit escape of DNAPL (7). Chemical compatibility between physical barriers and construction material must agree to insure the physical integrity of the barrier. The history of the performance of these containment technologies is poorly documented and is mainly offered here for completeness of review. A more complete review of these physical barriers is available (5,56).

Sheet piling involves driving lengths of steel that connect together into the ground to form an impermeable barrier to lateral migration of DNAPL. Ideally, the bottom of the sheet pile should be partially driven into an impermeable layer to complete the seal. Slurry walls involve construction of a trench which is backfilled with an impermeable slurry (bentonite) mixture. Grouting is a process where an impermeable mixture is either injected into the ground or is pumped into a series of interconnected boreholes which together form an impermeable boundary. Again, the main feature of these techniques is to physically isolate the DNAPL.

In summary, site characterization and remediation options for sites containing DNAPL are limited. Field data from site characterization and remediation efforts are also limited. This is largely due to the complexity of DNAPL transport and fate in the subsurface, poorly developed techniques currently available to observe and predict DNAPL in the subsurface, and to the fact that this issue has not been widely recognized until recently. Clearly, there is a growing realization within the scientific and regulatory community that DNAPL is a significant factor in limiting site remediation. Correspondingly, current research efforts within the private, industrial, and public sectors are focusing on both the fundamentals and applications aspects of DNAPL behavior in subsurface systems. Additionally, the number of field investigations reflecting an increased awareness of DNAPLs, is growing.

DNAPL Modeling

A modeling overview report identified nineteen (numeric and analytic) multiphase flow models which are currently available (60). Most of these models were developed for salt water intrusion, LNAPL transport, and heat flow. Four models are qualitatively described as immiscible flow models but do not specifically indicate DNAPL. A more recent model has been developed which simulates density driven, three phase flow, that is capable of modeling DNAPL transport (23). Presently, very little information is available on DNAPL modeling in the scientific literature.

Multiphase flow modeling involves modeling systems where more than one continuous fluid phase (NAPL, water, gaseous) is present. Modeling any subsurface system requires a conceptual understanding of the chemical, physical, and biological processes occurring at the site. Modeling of simultaneous flow of more than one fluid phase requires a conceptual understanding of the fluids and the relationship between the fluid phases. The significance of multiphase flow over single phase flow is the increased complexity of fluid flow and the additional data requirements necessary for modeling.

As presented earlier, numerous variables strongly influence DNAPL transport and fate, and consequently, the mathematical relationship of these variables is complex. Therefore, it follows that DNAPL modeling presents paramount technical challenges.

Presently, it is exceedingly difficult to obtain accurate field data which quantitatively describes DNAPL transport and fate variables within reasonable economic constraints. DNAPL transport is highly sensitive to subsurface heterogeneities (8,27,28) which compounds the complexity of modeling. Heterogeneities are, by nature, difficult to identify and quantify and models are not well equipped to accommodate the influence of heterogeneities. Additionally, relative permeability and capillary pressure functions must be quantified to identify the relationship between fluids and between the fluids and the porous media. Unfortunately, these parameters are very difficult to measure, particularly in three phase systems. Prior to an investment of time and money to model a given site, a careful evaluation of the specific objectives and the confidence of the input and anticipated output data should be performed. This will help illuminate the costs, benefits, and therefore, the relative value of modeling in the Superfund decision making process.

In summary, DNAPL modeling at Superfund sites is presently of limited use. This is mainly due to: the fact that very little information is available in the scientific literature to evaluate previous work; accurate and quantitative input data is expected to be costly; the sensitivity of DNAPL transport to subsurface heterogeneities; and, the difficulty in defining the heterogeneities in the field and reflecting those in a model. However, multiphase flow models are valuable as learning tools.

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Attachment 5

Project Health and Safety Plan Amendments

PROJECT HEALTH AND SAFETY PLAN AMENDMENT

AMENDMENT #: 1

PROJECT NAME: Waukegan Manufactured Gas and Coke Plant Site, Phase II Remedial Investigation

PROJECT NUMBER: 13/49-003 JSL 51

DATE: 04/03/93

REASON FOR AMENDMENT:

This amendment updates the work zones, personal protective equipment, and air monitoring instrumentation to be used for Phase II activities at the Waukegan Manufactured Gas and Coke Plant Site. It also includes the most recent data available on chemical substances of concern.

AMENDMENT:

A. TASKS

The following is a revised list of activities Barr personnel will perform on-site:

- Measure water levels in monitoring wells and at harbor well
- Survey boring and well locations
- Observe soil boring operations
- Observe monitoring well installations
- Observe monitoring well development
- Collect soil samples
- Collect water samples from monitoring wells
- Perform headspace screening
- Conduct slug and pumping tests
- Collect water samples from surface water bodies
- Collect water samples from the water treatment unit

B. WORK ZONES

Safety work zones will be established at each soil boring/monitoring well installation. The hot zone will be the area within an approximate three-foot radius of the borehole. The exclusion zone will be approximately equal to the height of the equipment boom plus ten feet. The contamination reduction zone will be located upwind of activities whenever possible. Entrance and exit from the exclusion zone will be done only through the contamination reduction zone. FIGURE A-1-WORK AND EXCLUSION ZONES FOR DRILLING ACTIVITIES illustrates site work zones.

C. POTENTIAL CHEMICAL HAZARDS ON-SITE

Tables A-1A through A-1D lists chemical substances of concern that have been found on-site.

TABLE A-1A
VOLATILE ORGANIC COMPOUNDS OF CONCERN ON-SITE

VOLATILE ORGANIC COMPOUNDS	MAXIMUM CONCENTRATION IN GROUNDWATER AND SAMPLE LOCATION (mg/L)	MAXIMUM CONCENTRATION IN SOIL AND SAMPLE LOCATION (mg/kg)
Benzene	1.5 (MW6D)	62 (T03W02)
Toluene	0.4 (MW6D)	140 (TT2303)
Ethylbenzene	0.1 (MW6D)	64 (TT2303)
Xylene	0.2 (MW6D)	370 (TT2303)

TABLE A-1B

SEMIVOLATILE ORGANIC COMPOUNDS OF CONCERN ON-SITE

SEMIVOLATILE ORGANIC COMPOUNDS (vapor pressures greater than naphthalene's)	MAXIMUM CONCENTRATION IN SOIL AND SAMPLE LOCATION (mg/kg)	MAXIMUM CONCENTRATION IN GROUNDWATER AND SAMPLE LOCATION (mg/L)
2-Methylphenol	29 (T03W02)	210 (MW3D)
4-Methylphenol	71 (T03W02)	730 (MW3D)
2,4-Dimethylphenol	32 (T03W02)	41 (MW4D)
Phenol	41 (T03W02)	1500 (MW4D)
Naphthalene	3500 (T03W01)	NA

TABLE A-1C

LOW VAPOR PRESSURE PAH COMPOUNDS OF CONCERN ON-SITE

PAHs WITH VERY LOW VAPOR PRESSURES (less than naphthalene's)	MAXIMUM CONCENTRATION IN SOIL AND SAMPLE LOCATION (mg/kg)
Acenaphthylene	300 (T03W02)
Acenaphthene	180 (TT0602)
Fluorene	280 (T03W02)
Phenanthrene	3701 (X-101S)
Anthracene	200 (T03W02)
Fluoranthene	370 (X-101S)
Pyrene	260 (X-101S)
Chrysene	160 (X-101S)
Benzo(b)Fluoranthene	73 (T03W02)
Benzo(k)Fluoranthene	90 (T03W02)
Benzo(a)Pyrene	90 (T03W02)
Benzo(a)Anthracene	150 (T03W02)
Indeno(1,2,3-c,d)Pyrene	35 (T03W02)
Benzo(g,h,i)Perylene	24 (T03W02)
Total cPAHs	700 (X-101S)
Total PAHs	5,000 (TT03W02)

TABLE A-1D
METALS OF CONCERN ON-SITE

METALS	MAXIMUM CONCENTRATION IN SOIL AND SAMPLE LOCATION (µg/g)	MAXIMUM CONCENTRATION IN GROUNDWATER AND SAMPLE LOCATION (mg/L)
Arsenic	1,820 (TT0701)	27.1 MW4D
Aluminum	12,500 (SS09)	NA
Antimony	73.5 (TT0701)	NA
Cadmium	4.4 (TT1402)	0.051 MW4D
Chromium	25.5 (SS15)	0.040 MW1D
Cyanide	956 (TT03W03)	0.71 MW4D
Lead	160 (X-105)	0.016 MW1D
Mercury	58 (X-107)	NA

NA = Information not available

X-105 = Illinois EPA sample June 14, 1989. 3.5-4.5 feet

X-107 = Illinois EPA sample June 14, 1989. 1-5 feet

MW1D = Barr Engineering Co. (BEC) sample, April 9, 1992

MW3D = BEC sample, April 7, 1992

MW4D = BEC sample, April 7, 1992

MW6D = BEC sample, April 8, 1992

T03W01 = BEC sample, March 13, 1992, 4 feet

T03W02 = BEC sample, March 13, 1992, 3.5 feet

TT0602 = BEC sample, March 9, 1992, 4.5 feet

TT0701 = BEC sample, March 19, 1992, 4.5 feet

TT1402 = BEC sample, March 18, 1992, 4 feet

TT2303 = BEC sample, March 19, 1992, 4 feet

SS09 = BEC sample, March 11, 1992, 2-4 feet

SS15 = BEC sample, March 7, 1992, 2-4 feet

D. PERSONAL PROTECTION LEVELS

The potential routes of exposure to chemical substances are expected to be the following:

- Inhalation of gases
- Inhalation of contaminated dust
- Skin contact with contaminated soil or liquid
- Ingestion by transmitting contaminants to the mouth after skin contact with contaminated solids and liquids

Personal protective equipment has been selected to protect against these hazards and is described in TABLE A-2 - HAZARD GROUPS FOR PROJECT TASKS and TABLE A-3 - PERSONAL PROTECTION LEVELS. These levels may be modified by the Barr Project Health and Safety Team Leader depending on specific site conditions, equipment configuration, air monitoring and results and previous experience. Tables A-2 and A-3 supersede Tables 2-3 and 2-5 in the February 1992 PHASP.

TABLE A-2

HAZARD GROUPS FOR PROJECT TASKS

TASK	HAZARD GROUP				
	0	1	2	3	4
NONINTRUSIVE ACTIVITIES					
Site Preparation <ul style="list-style-type: none"> Reconnaissance Perform geophysical survey Perform topographical survey 	✓	D1			
INTRUSIVE ACTIVITIES					
Drilling <ul style="list-style-type: none"> Observe soil boring operations Observe monitoring well installation Observe monitoring well development 			D2	D3	D4
Soil Sampling <ul style="list-style-type: none"> Collect soil samples from soil borings Perform headspace screening 			D2	D3	
Water Sampling <ul style="list-style-type: none"> Collect water samples from monitoring wells Conduct hydraulic conductivity tests Measure water levels in wells Collect surface water samples* 			D2	D3	D4
DECONTAMINATION ACTIVITIES					
Equipment DECON Operations <ul style="list-style-type: none"> Observe steam cleaning of equipment 					

✓ - Normal Work Clothes

* - Special situation, see Amendment Section F.

TABLE A-3

PERSONAL PROTECTION LEVELS

	D1	D2	D3	D4	C1	C2	C3	C4
GENERAL SAFETY EQUIPMENT								
Hard Hat ⁽¹⁾	R	R	R	R	R	R	R	R
Safety Glasses	R	R	R	R	R	R	-	-
Chemical Goggles/Face Shield	O	O	O	O	O	O	-	-
Hearing Protection ⁽²⁾	R	R	R	R	R	R	R	R
BOOTS								
Steel-Toed Boots/Insulated Steel-Toed Boots	R	R	R	R	R	R	R	R
Chemical Resistant Steel-Toed Boots ⁽³⁾	-	O	O	O	-	O	O	O
Boot Covers ⁽⁴⁾	-	R	R	R	-	R	R	R
CLOTHING								
Cotton Coveralls	-	O	-	-	-	O	-	-
Kleengard	-	R	-	-	-	R	-	-
Tyvek	-	O	R	-	-	O	R	-
Poly-Coated Tyvek (taped)	-	O	O	R	-	O	O	R
RESPIRATORS								
½ Mask Respirator with HEPA/OVAG cartridges	-	-	-	-	R	R	-	-
Full Face - with GMC-H cartridge	-	-	-	-	O	O	R	R
ELSA	-	O	O	O	-	O	O	O
GLOVES								
Inner Glove (Surgical)	-	R	R	R	-	R	R	R
Outer Glove (Nitrile, neoprene, monkey grip)	-	R	R	R	-	R	R	R

R = Required O = Optional - = Not Required

SPECIAL CONSIDERATIONS

- (1) Hard hat not required in the absence of construction activities or overhead physical hazards, unless required by the client.
- (2) Hearing protection is required during soil boring and monitoring well installation.
- (3) Chemical resistant steel-toed boots may be used instead of steel-toed leather boots and boot covers, if water is available for boot decontamination.
- (4) Boot covers or chemical resistant steel-toed boots not required when walking does not involve contact with contamination.

E. AIR MONITORING PROCEDURES

Air monitoring instrumentation that should be used for Phase II activities, and the intervals of use are specified in TABLE A-3 - AIR MONITORING INSTRUMENTATION REQUIRED ON-SITE. Air monitoring will be conducted in the breathing zone, and upwind and downwind for comparison purposes.

TABLE 1-3
AIR MONITORING INSTRUMENTATION REQUIRED ON-SITE

Monitoring Equipment	Task	Action Levels	Frequency	Record Data
Organic Vapor Analyzer	Monitoring Well Installations Soil Boring Soil Sampling Water Sampling Surveying	<3 ppm above background → Level D >3 ppm above background (for 10 min.) → Level C >50 ppm → Leave site and reassess	Periodic	Every hour (indicate range of values)
Detector tubes for benzene, phenol	Monitoring Well Installations Soil Boring Soil Sampling	None. Use data to modify organic vapor action level	Hourly when OVA levels >3 ppm	Each tube
Thermo-Luminescent Badge	Worn continuously while on site	NA	NA	NA

F. WATER SAFETY

Several surface water samples will be collected from Lake Michigan offshore of the site and the city beach. Samples will be collected in a small boat. There are no chemical hazards associated with the sample collection. The city beach has from time to time been closed to swimming due to elevated coliform count.

When operating a boat, the following rules will apply:

- All personnel in the boat will wear DOT approved personal floatation devices (PFD)
- There will be two people in the boat at all times
- If the boat is motor-powered, a set of paddles or oars shall also be kept in the boat
- The maximum weight and occupancy capacity of the boat will not be exceeded
- On-the-water operations will stop during inclement weather or high wind conditions

Since there is some probability that there may be an elevated coliform concentration in the water, personnel should avoid contacting water with their bare hand. Personnel should wash their hands thoroughly before eating or drinking and when they return to the shore.

G. APPENDICES

The attached Appendices document supersedes any previous Appendices issued for this project.

H. FIGURES

The attached figures supersede any figures referenced in the February 1992 PHASP.

___ Amendment discussed with Project Manager on _____ and approved.

X Amendment discussed with Project Industrial Hygienist on 04/12/93 and approved.

Preparer of Amendment

Date

Barr Project Health and Safety Team Leader

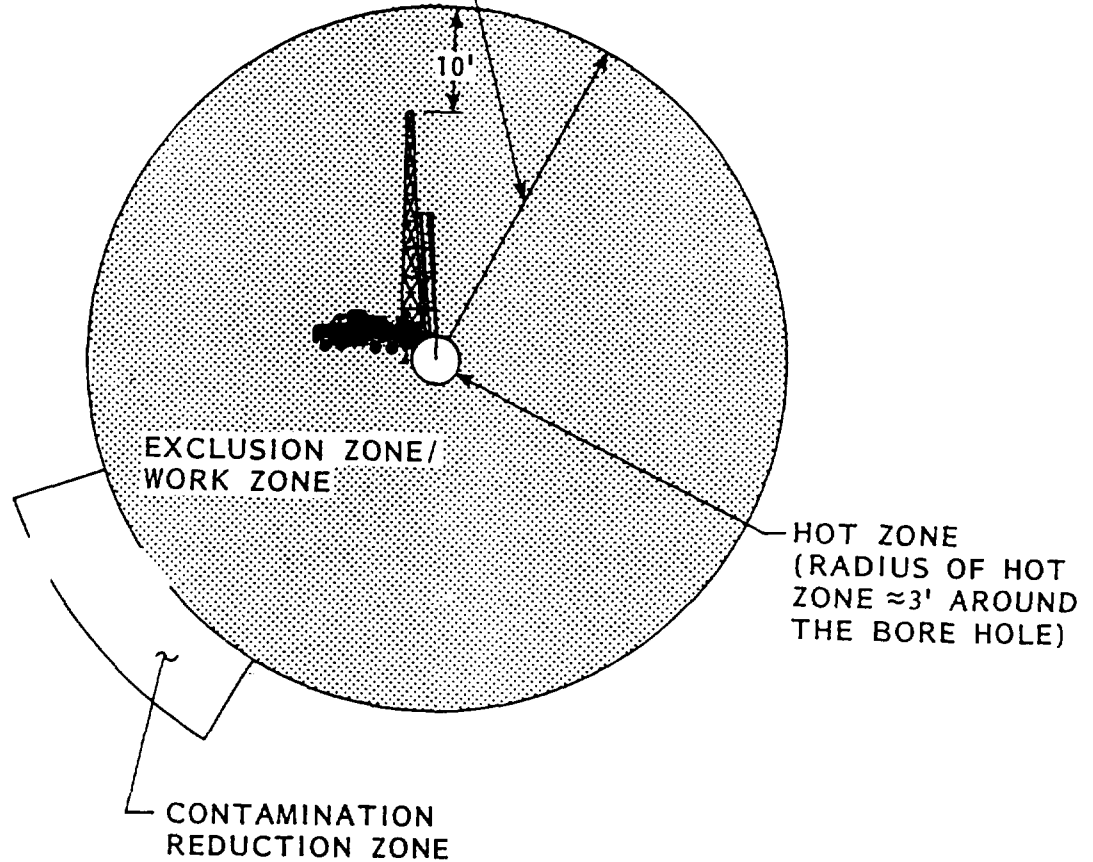
Date

NOTE: This Amendment form is to be used when there is a change in site tasks not considered in this PHASP.

c: Project Safety File
Project Manager
Barr Health and Safety Manager
Project Industrial Hygienist
Barr Project Health & Safety Team Leader

RADIUS OF EXCLUSION/
WORK ZONE = THE HEIGHT
OF THE EQUIPMENT BOOM + 10'

PREVAILING WIND
DIRECTION



Safety Work Zones to be Established at Each Boring/Monitoring Well Installation.

Enter and Exit Exclusion Zone Only Through Contamination Reduction Zone.

0 20 40
Approximate Scale in Feet

Figure A-1
WORK AND EXCLUSION ZONES
FOR DRILLING ACTIVITIES

PROJECT HEALTH AND SAFETY PLAN AMENDMENT

AMENDMENT #: 2

PROJECT NAME: Waukegan Manufactured Gas and Coke Plant Site, Phase II
Remedial Investigation

PROJECT NUMBER: 13/49-003 JSL 51

DATE: 05/12/93

AMENDMENT SECTION: 1.3 Organization and Coordination

REASON FOR AMENDMENT: Change in project personnel.

AMENDMENT:

Project Manager: James R. Langseth

Project Health and Safety Team Leader: Karlene French

Alternate Project Health and Safety Team Leader: John Fox

Project Industrial Hygienist: Colin S. Brownlow

___ Amendment discussed with Project Manager on _____ and approved.

___ Amendment discussed with Project Industrial Hygienist on _____
and approved.

Preparer of Amendment

Date

Barr Project Health and Safety Team Leader

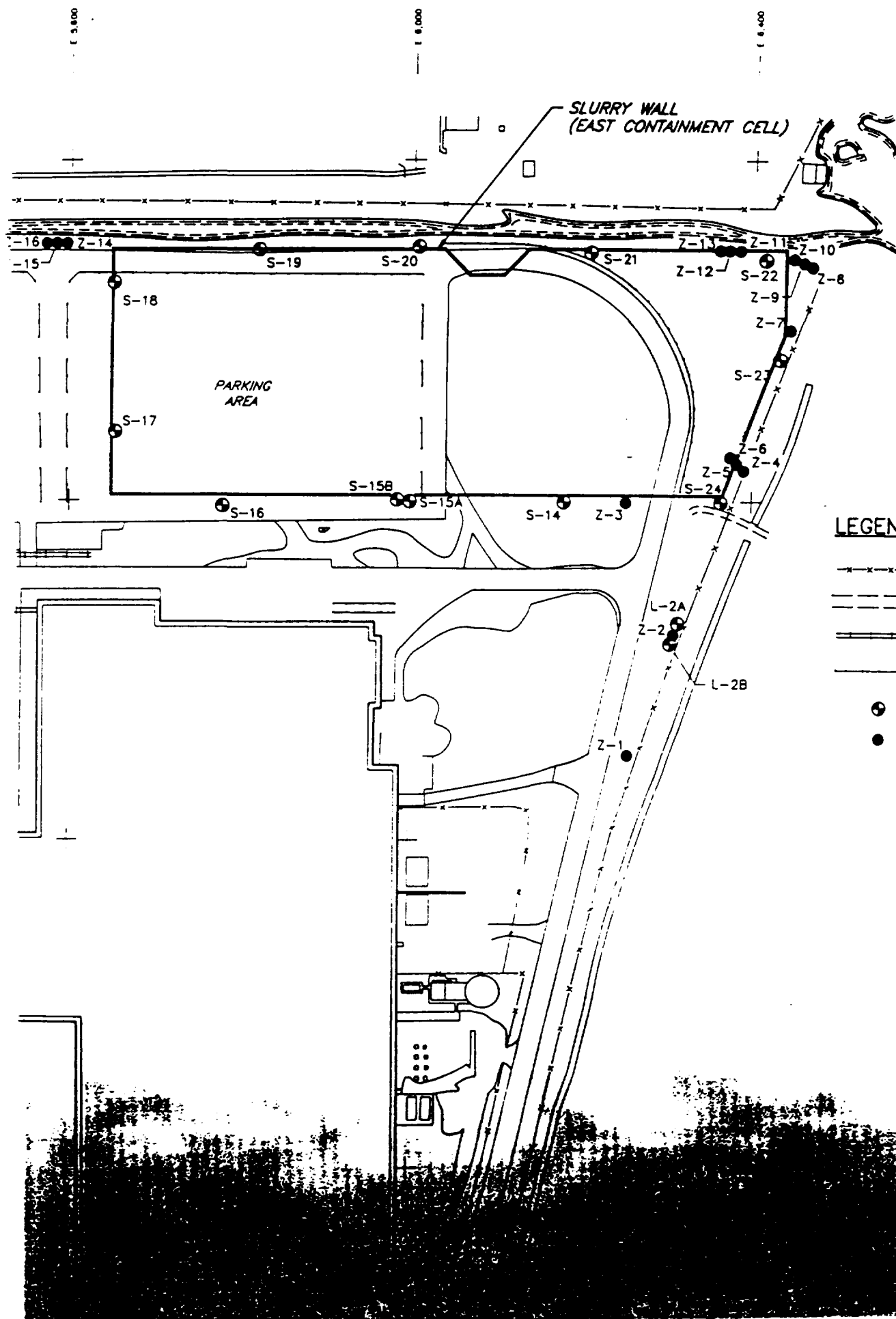
Date

NOTE: This Amendment form is to be used when there is a change in site
tasks not considered in this PHASP.

c: Project Safety File
Project Manager
Barr Health and Safety Manager
Project Industrial Hygienist
Barr Project Health & Safety Team Leader

Attachment 6

OMC Piezometer Location Map



Attachment 7

Phase II Analytical Parameters for Groundwater

ATTACHMENT 7

PHASE II ANALYTICAL PARAMETERS FOR GROUNDWATER

Polynuclear Aromatic Hydrocarbons

Naphthalene
2-Methylnaphthalene
Acenaphthylene
Acenaphthene
Dibenzofuran
Fluorene
Phenanthrene
Anthracene
Fluoranthene
Pyrene
Benzo(a)anthracene
Chrysene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Dibenzo(a,h)anthracene
Benzo(g,h,i)perylene
Carbazole

Phenolic Compounds

Phenol
o-Cresol
p-Cresol
2,4-Dimethylphenol

Inorganics

Arsenic (total, +III, +V)
Cadmium
Lead
Mercury
Selenium
Total ammonia
Total cyanide
Thiocyanate
Weak and dissociable cyanide
Amenable cyanide

Volatile Organic Compounds

Chloromethane
Bromomethane
Vinyl chloride
Chloroethane
Methylene chloride
Acetone
Carbon disulfide
1,1-Dichloroethylene
1,1-dichloroethane
1,2-Dichloroethylene
Chloroform
1,2-Dichloroethane
Methyl ethyl ketone
1,1,1-Trichloroethane
Carbon tetrachloride
Bromodichloromethane
1,2-Dichloropropane
cis-1,3-Dichloro-1-propene
Trichloroethylene
Chlorodibromomethane
1,1,2-Trichloroethane
trans-1,3-Dichloro-1-propene
Bromoform
Methyl isobutyl ketone
2-Hexanone
Tetrachloroethylene
1,1,2,2-Tetrachloroethane
Chlorobenzene
Styrene
Benzene
Ethyl benzene
Toluene
Xylenes

Attachment 8

Revised Attachment 4a- Standard Operating Procedure for the field Measurement of Soil pH

ATTACHMENT 8

REVISED ATTACHMENT 4A
(Revised June 14, 1993)

STANDARD OPERATING PROCEDURE
FOR THE
FIELD MEASUREMENT OF SOIL pH

PURPOSE: The purpose is to describe the method by which pH measurements on soil samples will be made and documented in the field.

RESPONSIBILITIES: The soil samplers are responsible for making and documenting the field soil pH measurements.

EQUIPMENT/MATERIALS: Orion Research Model 407A pH meter or equivalent pH meter
Paper cups (unwaxed)
Wooden tongue depressors
Distilled water

PROCEDURES:

1. The pH meter will be calibrated according to manufacturer's recommendations using pH standard solutions. (See Attachment 5A of the October 1991 Field Sampling Plan.)
2. As soon as possible after sampler retrieval, place a tablespoon of soil in a clean paper cup.
3. Add an equal amount of distilled water to the soil.
4. Stir the suspension several times with the wooden tongue depressor.
5. Place pH meter probe into the suspension.
6. Wait for meter reading to stabilize as directed by the manufacturer of the meter.
7. Rinse probe with a trisodium phosphate and water solution and then with deionized water.

DOCUMENTATION: pH values of samples will be written down on the field data sheet for the samples from each boring. The results will be reported as "soil pH measured in water."

***May 21, 1993 Letter from U.S. EPA with
Comments on the April 1993 RI/FS
Phase I Technical Memorandum***



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

REPLY TO THE ATTENTION OF:

May 21, 1993

MAY 24 93

Mr. Jim Langseth
Barr Engineering Co.
8300 Norman Center Dr.
Suite 300
Minneapolis, Mn. 55437

Dear Jim:

Enclosed please find the USEPA's comments on the RI/FS Phase I technical memorandum that was submitted for Agency review in April, 1993. Also attached are the IEPA's comments. Please review these comments and respond accordingly. If you have any questions or would like to schedule a meeting concerning these comments, please contact me at your earliest convenience.

Sincerely,

A handwritten signature in dark ink, appearing to read "W. J. Bolen", is written over the typed name.

William J. Bolen
Remedial Project Manager
U.S. EPA

encl. as

cc: S. Mulroney
T. Fitzgerald
T. Gowland

USEPA/IEPA Comments to Phase I Technical Memorandum
Waukegan Manufactured Gas and Coke Plant Site

General Notes

The Agencies submitted comments to Barr on this document in order that revisions would be made to make it an "approvable" document. If Barr or its clients do not agree with these comments, it is appropriate that this be brought to the Agencies' attention immediately. If, after discussions or agreements have resulted in settlement of those comments in dispute, it is inappropriate for Barr to imply that the Agencies made arbitrary conclusions. The document should simply state the mutually agreed upon conclusion without unnecessary and inappropriate references.

1. Sec. 2.2.2.3: Barr must evaluate all existing data before preparing the draft Remedial Investigation Report.

2. Sec. 2.4.2.2, Para. 4: The Agencies disagree that flow is occurring toward the southeast from the northeast corner of the site.

3. Sec. 2.4.4.2: The text states that no soil data is available from the ISGS. The text should explain the rationale for selecting the references cited in Table 2.4-6 to provide information on the natural composition of soils.

4. Sec. 2.4.5.1: Revise to read " The source of phenol in the sample from Well MW-3D is unknown at this time and will be investigated during Phase II sampling."

5. Sec. 2.4.5.1: The text does not explain the potential source of high arsenic concentrations in MW-5D and MW-6D. The text should state that the potential source of arsenic will be investigated during Phase II sampling.

6. Sec. 2.4.5.3: Phase II sampling activities will include monitoring well sampling from off-site areas. This must be reflected in the text.

7. Sec. 2.4.6, Pg. 55, Para. 4: Strike "at the" from the first sentence.

8. Sec. 3.3.1: The text states that " If free-phase oil or tar is found near the base of the groundwater unit, Well MW-9D will be screened above the level of the tar or oil." If such a condition exists, a sample must be collected and analyzed for characterization. It is a requirement of this investigation that the extent and type of contamination must be fully defined.

9. Sec. 3.3.4: The text should refer to Fig. 3.2-1, which

identifies the locations of clay till permeability tests.

10. Sec. 3.3.4: The test states that the treated water will be discharged to the ground near sampling locations SS-12 and SS-13 at a rate of 10 gallons a minute. The text should also include a time interval for monitoring this activity to ensure that water does not flow off site or affect groundwater elevations in nearby monitoring wells.

11. Sec. 3.5.1: Samples collected for TCLP analysis should not be mixed - this may result in increased volatilization.

12. Sec. 3.6.1: Tables 3.6-1 and 3.6-2 indicate that the risk assessment will take approximately 4 weeks for PRC to complete. PRC will require approximately 10 weeks to complete this task. This assumes that PRC will not conduct an ecological assessment and that this assessment will be completed by Barr. Be advised that PRC cannot begin the risk assessment until all data have been validated and approved by the USEPA. In addition, work cannot start on the assessment until the Agencies have approved the Preliminary Characterization Summary. Finally, the Agencies require a 30 day review period. Revise these tables accordingly.

13. Table 2.4-7: Results listed for methylene chloride and carbon disulfide are incorrect.

14. Table 3.2-1: The table indicates that the number of groundwater wells sampled during Phase II to assess potential treatability alternatives has been reduced from 21 to 10. An explanation for this revision is required.

15. App. I: The Agencies do not agree that the aquifer base is horizontal - Phase I data indicates otherwise.

16. App. I: An explanation is required as to why the assumed hydraulic conductivity is 20 ft/d offsite when the model uses 6 ft/d beneath the site.

17. App. I: The tech memo will address and include in Phase II modeling additional groundwater elevation data, more measuring events, and additional hydraulic conductivity data from slug and pumping tests. This data should be used to address data gaps and reduce the number of simplifying assumptions in the model. If the data cannot achieve this, the uncertainties of the model should be clearly stated in the text.

18. App. K: This standard operating procedure is a copy of Rev. 0 of the source method and is not a lab SOP. Revision 1 was issued in November 1990 and should be incorporated as an SOP presented in the same style as the alkalinity and acidity SOPs in this appendix.

19. App. K: This SOP is a copy of the source method. However, it omits essential references to issues such as interferences and

apparatus, some reagents, and many procedures used.

*State of Illinois***ENVIRONMENTAL PROTECTION AGENCY**

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

(217) 782-6762

May 20, 1993

Mr. William Bolen
Waste Management Division
Office of Superfund
IL/IN Remedial Response Branch
HRSL-6J
USEPA, Region V
77 West Jackson Blvd
Chicago, Illinois 60604

Re: L0971900047 Lake Co.
Waukegan Coke Plant Phase II RI

Dear Mr. Bolen:

Enclosed are the IEPA's comments on the first volume of the Tech Memo and first appendix, as well as the Revised Technical Memorandum, and Proposed Modeling for the RI/FS, that was received April 13, 1993.

The monitoring wells and piezometers that were installed during the phase I RI had all the purge water discharged to the surface at the site. Even though the water had been treated in the field, prior to the discharge, it was released near an area where gross contamination was found in the trenches. By allowing the discharge of over 7,400 gallons, additional contamination migration vertically and laterally may have occurred in the groundwater. It is the state's position that we should not allow this type of activity to occur for an area that has large amounts of gross contaminants present, but rather the effluent be disposed of via the near by POTW, an NPDES permit, or an alternative treatment technology.

The groundwater modeling provided showed that the flow direction for the discharge area used in Phase I was towards the beach. The present modeling indicates that the flow direction for the proposed area of discharge for the Phase II would be towards the Waukegan harbor. Even if this area is free of gross contaminants from the surface to the water table, the groundwater will contain constituents from the



State of Illinois

ENVIRONMENTAL PROTECTION AGENCY

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

contaminated site and will be flowing towards the harbor. By allowing the discharge of treated water to the ground surface additional drive water will be introduced to the aquifer and contaminants will be further dispersed towards the harbor.

The use of sprinkling systems or reinjection as part of the final remedy are viable options for this site. These alternatives must be used, however, in conjunction with groundwater boundary controls, so that the remedy will not allow the additional migration of contaminated groundwater to leave the site and further effect the beach, Lake Michigan, or the Waukegan harbor. This Agency's position is to be consistent with the intent of the remedy.

The option of sending wastewater to a local POTW should be considered. Depending on the choice of treatment and transport to the POTW, several regulations and requirements will be applicable.

1. Installation of a sewer line requires a construction permit for the sewer connection: 35 Ill. Adm. Code 309.202;
2. Construction of a pretreatment system requires a construction permit: 35 Ill. Adm. Code 309.202; and also requires an operating permit if the POTW receiving the discharge does not have a Federally approved pretreatment program pursuant to 40 CFR 403: 35 Ill. Adm. Code 309.203.
3. The general and specific pretreatment requirements: 35 Ill. Adm. Code 307.1101 and constituent specific requirements 307.1102-1103 apply to discharges to POTWs.
4. Discharges to POTWs are also subject to any applicable Federal standards, including General Pretreatment Standards at 40 CFR 403 and the National Categorical Pretreatment Standards at 40CFR 405-471.
5. The POTW or wastewater treatment works receiving the discharge may have local discharge standards for pollutants, general and specific discharge prohibitions, monitoring and reporting requirements, and permitting requirements.
6. Operation of a treatment works must be under the direct and active supervision of a certified operator: 35 Ill. Adm. Code 312.101.
7. If wastewater is trucked to the POTW, a sewer connection permit is always required pursuant to 35 Ill. Adm. Code 309.202. Transport of this wastewater to a POTW likely requires a special waste stream authorization from the Division of Land Pollution Control, and may be subject to 35 Ill. Adm. Code 721, 808, and/or 809. This application is typically submitted along with the construction/operating permit application submitted to the Division of Water Pollution Control and undergoes a coordinated review by those

*State of Illinois***ENVIRONMENTAL PROTECTION AGENCY**

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

divisions.

8. POTWs review all proposed sewer hardware and pretreatment systems prior to the discharger's submittal of that information in a permit application to the Division of Water Pollution Control.

9. If for any reason this discharge becomes a direct discharge to surface water and thereby subject to NPDES regulations at 40 CFR 122, the discharge standards, the permitting requirements, and the sampling, monitoring, and reporting requirements are different from those described above for an indirect discharge.

The application process for an NPDES permit, can be expected to take at least 2 months plus a 45 day public comment/notification period. Application for a permit to discharge to a POTW will be processed by the Division of Water Pollution Control within 90 days of receipt.

The deletion of compounds from the site investigation analysis may be acceptable. Questions do remain in the present text as to the fire training and storage of petroleum and PCB's on site by OMC. These areas have not been identified on the facility maps. If the types of compounds used in the fire training, the locations for such, as well as the storage areas were known, then removing compounds for the entire site investigation list would be more feasible. At the meeting in Chicago chlorinated compounds were stated as not being a component of the facility's previous processes and were to be considered for removal from the analytical list. Information as to the types of compounds used by OMC should be considered before removing any compounds.

All compounds that are detected in an analysis should be listed. Those that are not detected should simply be labeled non detected and the detection limits given for each analysis. Those compounds that have been proposed for removal from the Phase II analysis that would require additional analysis for those compounds can be removed, since they were not found around the site previously during Phase I.

Boring locations for highly contaminated areas should have casing set and deep drilling be done inside. Hydrated bentonite around the outside of the casing will stop the vertical migration of the free flowing contaminants observed in Phase I. This will reduce the amount of gross contamination and help the data be more representative of the site conditions.

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Soil cuttings and purge water from off site installations should be required to be brought back to the site and stored, or treated appropriately.

Cuttings on site may be in areas of fire training, where the RCRA classification has not been determined. Listed compounds may be present and would trigger the Land Disposal Restrictions. The only soil that should be placed on the ground after drilling is complete, is soil that does not register a reading on hand held field screening devices when brought up on augers, or when split spoons are opened. Coming back later after spreading the soils and taking a reading is not acceptable.

In 3.2.2 surface soil samples are described as to be taken from the 0-6" range for VOA's. This interval should be moved down to at least 6-12" so as to account for the volatilization of compounds from this interval previously, thus altering the concentration that would have been detected in the analysis.

Is the Soil Stockpile Soil Samples in section 3.2.3.1 for the pile from the dredging of the harbor, or the new slip. If it is the surface impoundment, the bottom liner should not be drilled through and sampled since it can not be resealed afterwards.

Those wells that are installed in areas where the possibility of free flowing contamination exists should be installed using a sealed casing and internal drilling the depths required for the installation. This will eliminate the potential for vertical migration of the contaminants.

The sampling described in 3.4.1.1 should include the collection of the initial volumes of oil/water in the deep till wells that produce very dark or oily discharge. By pumping the wells of this material first and then sampling the water that is drawn in after, the amounts of DNAPL that are at the base of the till will be misrepresented, since the water will flow towards the screens and only produce a minimal amount of DNAPL.

With respect to the water being discharged on the site, in section 3.4.2 it states that the Harbor will receive groundwater from the site, and is part of a focus for evaluating the potential environmental impacts this direct discharge of groundwater has, and is, producing. They shouldn't even be asking to discharge to the ground based on

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the data that is already available on the harbor's environmental impacts. This section also states that the groundwater quality impact to the surface waters will be determined via the model. Subsequently, at this point of the investigation, they do not know the impact of any water that percolates down and drives groundwater offsite. This is especially of concern considering the geology for this site. The cross sections shown in Figures 2.4-2 and 2.4-3, indicate fill and sand down to the till.

The data presented in Figure 2.4-8 lists the cyanide concentrations in the monitoring wells. All perimeter wells show cyanide present at the deep till locations. The well MW-5D is directly inline with the presently modeled groundwater flow. It has cyanide present at 526 ppb, arsenic levels at 9220 ppb in figure 2.4-9, and is situated approximately twelve feet from the harbor. Discharge of the sites pollution control water here would wash those contaminants towards, or into the harbor.

Those wells that are placed off site at the beach should have the geologist determine that the wells are set at the proper depth to catch the DNAPL contamination that would be migrating along the top of the till layer towards Lake Michigan.

Pollution Control Wastes are regulated under either the RCRA hazardous waste requirements, or the Special waste regulations in 35 IAC Subtitle G Section 809.

3.4.1.1 Monitoring well development water should be treated and disposed of according to comments noted previously.

3.2.1.1., 3.3.1. states that boreholes will be abandoned with neat cement grout. The IEPA has concerns about this procedure with regard to site remedy. If any soil has to be removed, the cement backfill will obviously need to be removed as well. This procedure could weaken the structural integrity of the cement grout at greater depths, possibly allowing contamination to move into previously uncontaminated areas.

2.4.4.4. #1. states that no PCB analysis is to be run on soil samples. The IEPA missed the discussion regarding this issue and wanted to voice concerns about the lack of PCB analysis in Phase II.

If you have any questions please feel free to call me, my direct line is (217) 582-9882.

*State of Illinois***ENVIRONMENTAL PROTECTION AGENCY**

Mary A. Gade, Director

2200 Churchill Road, Springfield, IL 62794-9276

Sincerely, -

Gerald E. Willman

Gerald E. Willman
Project Manager
Federal Sites Management Unit
Remedial Project Management Section

***Remedial Investigation/Feasibility Study
Phase I Technical Memorandum***

***Waukegan Manufactured Gas
and Coke Plant Site
Waukegan, Illinois***

***Prepared for
North Shore Gas Company***

***Under the Administrative Order on Consent Re: Remedial Investigation and
Feasibility Study for the Waukegan Manufactured Gas and Coke Plant Site
Waukegan, Illinois***

April 1993

Barr

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TECHNICAL MEMORANDUM
PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WAUKEGAN MANUFACTURED GAS AND COKE PLANT

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SECTION 1

INTRODUCTION

1.1 SCOPE OF DOCUMENT

This technical memorandum has been prepared to fulfill Subtask I.8 of the Remedial Investigation/Feasibility Study (RI/FS) Final Work Plan for the Waukegan Manufactured Gas and Coke Plant (WCP) site in Waukegan, Illinois. The purpose of this memorandum is to: (1) summarize the data collected during Phase I of the RI/FS; and (2) refine the design of the Phase II investigation.

The Phase I investigation was conducted in accordance with the documents listed below. These documents were approved by the United States Environmental Protection Agency (U.S. EPA) on the dates listed.

- Remedial Investigation/Feasibility Study, Final Work Plan, October 24, 1991 - Final U.S. EPA approval on November 15, 1991.
- Final Sampling and Analysis Plan, Volume I: Field Sampling Plan, October 24, 1991 - Final U.S. EPA approval on November 15, 1991.
- Final Sampling and Analysis Plan, Volume II: Quality Assurance Project Plan, October 24, 1991 - Final U.S. EPA approval on January 9, 1992.
- Project Health and Safety Plan - Final U.S. EPA approval on November 15, 1991.

Site access to begin remedial investigation work was obtained on February 26, 1992.

1.2 SITE LOCATION

The WCP site is located in Waukegan, Illinois, approximately 35 miles north of Chicago. The site is located on a peninsula on the east side of Waukegan Harbor. For the purposes of this report, the word "site" means the area shown on Figure 1.2-1, and is not intended to limit the broader CERCLA meaning of the word "site." The site's background and history are briefly summarized below. Greater detail on background information regarding the site was previously

presented in a technical memorandum (Barr, 1990) and in the Final Work Plan for the RI/FS (Barr, 1991b).

1.3 SITE OPERATIONS

1.3.1 Wood Treating Plant

Based on information obtained from the Elgin, Joliet, and Eastern Railway Company (EJ&E) (EJ&E, 1990), the first industrial facility located on the site was a wood treating plant. This operation was located on the western portion of the site (Figure 1.3-1) and was operated by the Chicago Tie and Timber Company from approximately 1908 to 1912. The plant consisted of at least four steel creosote storage tanks, a wood planing building, an overhead steel conveyor belt system, two creosote weighing vanes located due east of the storage tanks, and a storage building for the treated railroad ties (EJ&E, 1990; Sanborn, 1917; U.S. ACE, 1908). The storage building for the finished product and a 250-foot long, 8-foot high concrete retaining wall (connected to the south edge of the storage building) ran parallel to the EJ&E railroad side tracks.

Available information indicates that the untreated railroad ties were transported by the conveyor to the treating building where they were dipped in vats of creosote. The treated ties were likely transferred to the storage building for future distribution by rail or ship. It is not apparent from the existing data how or where the ties were dried. As a result, the possibility that ties were drip-dried on land used for the creosoting facility operations cannot be eliminated. Based on a review of Sanborn Fire Insurance Maps, the wood treating plant was dismantled some time after 1917.

1.3.2 Waukegan Coke Plant

In 1927, EJ&E sold the entire property to the William A. Baehr Organization, which in turn sold the property to the North Shore Coke and Chemical Company. Between 1926 and 1928, a coke oven gas plant was designed and constructed under the direction of the William A. Baehr Organization. This gas plant sold their excess gas production to North Shore Gas Company.

Coal tar and ammonia were by-products of the manufactured gas production. The Coke Company plant included equipment with which gas by-products were extracted and prepared for the market. Figure 1.3-1 shows the locations of the major structures formerly present on the original gas plant site, including the by-products building, tar tanks, tar storage tank, and ammonia tank.

In addition to by-product removal, operations at the site included removal of sulfur and naphthalene from the raw gas for gas purification. The gas was treated for sulfur removal on the Coke Company property using equipment owned by North Shore Gas Company (NSG), to whom the Coke Company sold its gas. The purified gas was sent by transmission pipelines for ultimate distributions to the NSG service territory (Duff and Phelps, 1940). The gas purification operations used a liquid sulfur removal process (Thylox) and were conducted at the thionizer building (Figure 1.3-1). The common sulfur removal process using oxide boxes was not employed at this plant.

In 1941, North Shore Gas Company acquired the assets of North Shore Coke and Chemical Company, including the coke plant. The plant was operated as a manufactured gas production facility for 19 years, until General Motors Corporation (GM) purchased the property in 1947. After the transfer of ownership to GM, the primary function of the plant was to supply coke for a foundry in Saginaw, Michigan. Coking operations are similar to MGP operations using the coal carbonization process, except that gas produced during the coking process is not necessarily purified or retained for distribution. The production of coke oven gas during coking at the WCP site was limited to internal use only due to the conversion of NSG to natural gas in 1947. The gas purification facilities and sulfur removal equipment were dismantled by GM because the coke oven gas was only used on-site. The plant was operated as a coke production facility for about 24 years.

1.3.3 Outboard Marine Corporation Facilities

GM sold the property to Outboard Marine Corporation (OMC) in two parcels in 1969 and 1971. The plant facilities were dismantled at the direction of OMC in approximately 1972. The specifications for demolition of the coke plant facilities provided for the removal of all of the buildings, smoke stacks,

equipment, railroad tracks, and ties (OMC, 1972). After the demolition and removal of the coke plant, OMC used the property for various operations and activities, including: data processing building constructed and currently maintained on the southeastern portion of the property; quality control and durability testing of products using a tower in the southwest corner of the site (OMC, 1990a); temporary storage of construction materials and semitrailers; and storage of waste oil and petroleum products. Larsen Marine has also leased portions of the site for the storage of boats and boat racks.

During the latter part of 1990, OMC, through the Waukegan Harbor Trust, began construction of a new slip to be used for boat servicing. The new slip is located near the northwest corner of the site (Figure 1.3-1). The new slip was constructed to replace Slip No. 3, located west of the new slip across Waukegan Harbor, which was formerly used for the boat servicing operations of Larsen Marine. Slip No. 3 is planned to be filled with sediments containing PCBs and subsequently capped as a remedial action for PCB contamination in the Waukegan Harbor.

1.4 WASTE TYPES POTENTIALLY ASSOCIATED WITH SITE OPERATIONS

Waste materials that may be associated with OMC operations include PCBs and industrial chemicals used at adjacent facilities and petroleum products stored on-site. The waste types and associated chemicals of concern typical for coking and coal gasification facilities are well documented (GRI, 1987). At the WCP site, the list of potential waste materials also includes materials that may be associated with the former wood treatment facility in the western portion of the site.

Coking, coal gasification, and wood treating processes may each have resulted in the release of coal tar products and sludges to the environment. Coal tar or creosote can migrate as a separate, nonaqueous phase in soil and groundwater systems. In addition, dissolved compounds of coal tar or creosote can migrate with surface water, water infiltrating through soils, and groundwater flow. Coal tar and sludges are composed of hundreds of different compounds including polynuclear aromatic hydrocarbons (PAHs), phenols, and volatile aromatics. Metals and inorganic compounds contained in oils,

by-products, and wastes associated with coal tar may also be present. Table 1.4-1 presents a list of chemicals likely to be associated with waste materials resulting from coking, coal gasification, and creosoting operations (GRI, 1987). Physical and chemical characteristics of coal tar and creosote are discussed below.

1.4.1 Coal Tar

Coal tar, whether from a manufactured gas plant or a coking facility, is a by-product of coking bituminous coal. The constituents of a typical coal tar from a coal carbonization process (used at the WCP site) are summarized in Table 1.4-2.

Coal tar is only slightly soluble in water, and may be present in soils and groundwater as a separate nonaqueous phase fluid. Coal tar generally discolors and leaves a distinctive oily residue in materials it encounters. Coal tar is more dense than water and may migrate as a separate phase primarily under the influence of gravity. Downward migration of coal tar will generally be limited when a contact with low permeability material is reached. Lateral migration may then be controlled by the slope of that contact. Pockets of concentrated coal tar are likely to be persistent because the mixing with groundwater required for solubilization and the aeration required for biodegradation are likely to be very limited in the subsurface environment. The PAH and volatile aromatic compounds of concern typically associated with coal tars are listed in Table 1.4-1.

1.4.2 Creosote

Creosote is generally described in terms of its physical properties, summarized in Table 1.4-3. These properties are similar to the corresponding properties for coal tar. One of the principal differences evident from Table 1.4-3 is that the fraction of pitch (residue above 355°C) is much higher in coal tar than in creosote. Conversely, tar acids (phenolics), typically constitute a larger fraction of creosote than of coal tar. The chemical composition and properties of creosote are not uniform because creosote is produced from a blend of the fractional distillates of coal tar, sometimes

diluted with coal tar or petroleum oil. Environmental fate and transport properties of creosote are similar to those described above for coal tar, although creosote may be more mobile than coal tar due to its lower viscosity and differences in surface tension.

1.5 REGIONAL GEOLOGY AND HYDROGEOLOGY

Waukegan is located in a glaciated area of Northeastern Illinois. The region is characterized by a series of north-south trending morainal ridges and intervening alluvial deposits that form the valley floors. Glacial deposits are interbedded with alluvial deposits associated with sedimentation and erosional processes related to Lake Michigan and its fluctuating water levels over the past 10,000 to 12,000 years (Reinertsen, et al., 1981).

The WCP site is located on a flat-lying peninsula which is separated from the mainland by Waukegan Harbor. The site is bounded on the south and east by Lake Michigan, and on the west by Waukegan Harbor. The peninsula lies at an average elevation of approximately 585 feet MSL.

Waukegan Harbor is a manmade structure constructed in the late 19th and early 20th centuries. Prior to construction of the harbor, the area located east of the original shoreline (i.e., the site location) was composed of a complex series of natural and manmade inlets and islands. Portions of the site and much of the site vicinity were filled and reclaimed.

1.5.1 Unconsolidated Sediments

Surficial deposits in the vicinity of the site consist of shallow water near-shore lake sediments (beach, bar, spit, delta, lacustrine, and other wetland deposits) of the Dolton Member of the Equality Formation. These deposits are predominantly medium-grained sand with gravel. Underlying the Equality Formation is a relatively thick unit of mostly gray clay and sandy clayey till with some pebbles and cobbles; this glacial deposit is termed the Wadsworth Till Member of the Wedron Formation. The total depth of unconsolidated deposits in the vicinity of the site is reported to be between 50 feet and 200 feet (Lineback, 1979; Hughes, et al., 1966).

The sand and gravel deposits within the glacial materials are used extensively for groundwater production in some areas. Where the deposits are thick and relatively continuous, pumping rates as high as 1,000 gpm are possible (Hughes, et al., 1966).

1.5.2 Bedrock Units

Underlying the unconsolidated deposits are the dolomitic (Silurian) Racine¹, Waukesha, Joliet, Kankakee, and Edgewood Formations. Depth to bedrock is reported to be between 50 and 200 feet in the region. The bedrock topography is complex, having been eroded prior to and during the last glaciation. Bedrock valleys are present in the Waukegan area, several with total relief of more than 100 feet. Most of these valleys trend west to east. Below the dolomite lies Ordovician rocks, including: the Maquoketa Formation limestone and shales; the Galena-Platteville Formation limestone and dolomites with minor shale; the Ancell Formation (St. Peter Sandstone); and the Prairie du Chien Formation (Willman, et al., 1967).

The bedrock units form three major aquifer systems in northeastern Illinois. The uppermost shallow bedrock aquifer consists of the Silurian dolomites. The underlying Maquoketa Group shales hydraulically separate the Silurian aquifer from deeper units. The shallow bedrock aquifer is recharged through the glacial deposits and is generally in hydraulic connection with the glacial deposits and major surface water features.

The deeper aquifer systems include the Cambrian-Ordovician aquifer and the Mt. Simon Aquifer. These hydrogeologic units are recharged where they outcrop or where they immediately underlie the glacial deposits. In general, the recharge areas are located to the north and west of Waukegan. The deeper units may also receive some recharge through the Maquoketa Group.

Regionally, groundwater is produced from all three bedrock aquifers with the majority of production from the Cambrian Mt. Simon Sandstone; however, few

¹The Racine Formation may be as much as 500 feet thick. No site-specific data are available.

wells penetrate the Mt. Simon Aquifer in the immediate Waukegan area (Hughes, et al., 1966).

SECTION 2
PHASE I REMEDIAL INVESTIGATION

2.1 INTRODUCTION

Phase I involved an investigation of facility foundation locations and preliminary delineation of the lateral extent of shallow soil contamination using test trenching. On-site soil samples were collected from test trenches and surficial soil borings and analyzed to provide preliminary characterization of soil contaminants. Background surficial soil samples from off-site locations were also collected and analyzed. Phase I included the installation of on-site monitoring wells and piezometers to make a preliminary determination of groundwater flow directions at the site and guide the selection of further monitoring well locations and analytical parameters for Phase II. Slug tests were performed at the Phase I monitoring wells and groundwater samples were collected and analyzed to provide an initial assessment of groundwater quality.

2.2 DATA COLLECTION ACTIVITIES

This section describes the Phase I field activities, summarizes the objectives of each activity, and describes the methods used to gather the necessary data. Phase I field activities included:

- Collection of background soil samples for laboratory analysis of soil quality;
- Collection of surficial soil samples for laboratory analysis of soil quality;
- Excavation of test trenches and installation of pilot borings;
- Collection of soil samples from test trenches and pilot borings for description and geologic interpretation and for field screening and laboratory analysis of soil quality;
- Installation of piezometers and monitoring wells;

- Measurement of water levels;
- Collection of groundwater samples for laboratory analysis of groundwater quality;
- Performance of hydraulic conductivity testing; and
- Survey for location and elevation of site structures, test trenches, surficial soil borings, pilot borings, piezometers, and monitoring wells.

This section is organized into the following subsections:

- Soil Quality/Contaminant Distribution Investigation
- Hydrogeologic Investigation
- Groundwater Quality Investigation
- Ecological Survey Methods

2.2.1 Soil Quality/Contaminant Distribution Investigation

The Phase I soil quality/contaminant distribution investigation consisted of potential source area investigation, background soil sampling, surficial soil sampling, and pilot borings. Investigation objectives and methods are described below.

2.2.1.1 Potential Source Area Investigation

The objectives of the potential source area investigation were to:

- Provide data on the locations of historical structure foundations for orientation and preparation of a site map;
- Delineate visually the lateral extent of shallow soil contamination in areas identified as potential source areas (based on knowledge of the site's operational history); and

- Obtain a limited number of soil samples to be used in a preliminary characterization of site soil contaminants.

The primary method used for the potential source area investigation was the excavation of test trenches. Thirty (30) test trenches were placed in the locations shown on Figure 2.2-1. These locations were selected to coincide with the locations of facility operations and potential waste placement areas (e.g., ponds). Test trenches were not excavated through or beneath remaining foundations. Three test trenches (TT-05, TT-05E, and TT-06) were excavated at the former creosoting facility in order to supplement existing data for this area. One of these trenches (TT-06) was excavated west from the former creosoting facility location and adjacent to the southernmost portion of the new slip and was used to characterize the layer of coal fines found to be present along the southernmost portion of the new slip (Canonie, 1991).

Wherever possible, test trenches were extended from areas of visible contamination to areas that appeared to be clean. If contaminated zones were encountered in a test trench, an additional trench was placed approximately perpendicular to the original trench in order to further delineate contaminated areas. Trenches were extended to depths slightly below the water table and were logged and photographed as they were placed. Excavated materials were placed back into the same trench at the end of the day. Details of the methods used to excavate, log, and survey the test trenches, as well as the procedures used to decontaminate equipment, are described in Section 3.3 of the October 1991 WCP RI/FS Final Field Sampling Plan (FSP). The test trench logs are in Appendix A. Survey notes are in Appendix B.

Two former ponds, identified from aerial photographs, were investigated. Because parking lots currently cover these locations, Shallow Soil Borings (SC-01 and SC-02) were used to investigate these areas. The locations of these borings are shown on Figure 2.2-1. The samples were collected using hollow stem auger drilling techniques and split-spoon barrel sampling techniques. The procedures used for soil boring advancement, equipment decontamination, soil cuttings disposal, logging, soil classification, and surveying are described in detail in Section 3.5 of the October 1991 FSP. The logs for these soil borings are in Appendix C. Survey notes are in Appendix B.

Soil samples collected from the test trenches and soil borings were examined using field screening methods. The field screening methods included field soil classification, visual observations, field oil sheen screening, and field headspace organic vapor screening. The soil sampling procedures and equipment and the field screening methods that were used are described in detail in Sections 3.4 and 3.5 and Attachment 4 of the October 1991 FSP. At the soil borings, where the volume of soil in the split-spoon barrel was not sufficient to fill all of the sample containers, it was necessary to collect soil from the auger flight as well as the split-spoon barrel. Field screening results for the soil samples collected from the test trenches and soil borings are summarized in Table 2.2-1 and presented in the test trench logs in Appendix A and on the boring logs in Appendix C. Soil samples locations are shown on Figure 2.2-1.

Based on the field screening results, soil samples were selected for laboratory analysis. At least one sample was selected for analysis from each distinct area of soil contamination as determined by field observations. One sample was also collected from the coal fines layer found to be present along the southernmost portion of the new slip and from each of the soil borings in the former pond areas. Additional soil samples were selected for analysis from areas that appeared to be near the limit of visible contamination and from areas that showed no visible evidence of contamination. Samples that were submitted for laboratory analysis are listed in Table 2.2-2 and are marked on the test trench and soil boring logs in Appendices A and C.

All the samples collected from the test trenches for laboratory analysis were analyzed for PAHs and volatile organic compounds (VOCs). Approximately 20 percent of the samples were also analyzed for phenolic compounds. Samples from trenches located near the thionizer building were also analyzed for cyanide and arsenic. One sample of soil with visible coal tar contamination and one sample of visibly contaminated soil from the area of the former creosoting facility were analyzed for the full-scan target compounds (semivolatiles, VOCs, cyanide, metals, pesticides, and PCBs). One sample from each of the shallow soil borings in the areas of the former ponds was analyzed for the full-scan target compounds. One sample of the compacted coal fines layer was analyzed for the full-scan target compounds and was analyzed using the Toxicity Characteristic Leaching Procedure (TCLP) for the full list of toxicity

characteristic constituents. Details of the sampling procedures that were used are described in the October 1991 FSP. Laboratory analytical methods and quality control sampling procedures that were used are described in detail in the October 1991 WCP RI/FS Final Quality Assurance Project Plan (QAPP). Analytical results are presented in Tables 2.2-3 through 2.2-8. The tables report the data for the project-specific parameters listed in Tables 3.4-3 and 3.4-4 of the QAPP. Extra parameters that were analyzed by the laboratory are included in the laboratory analytical data packages in Appendix D.

2.2.1.2 Background Soil Sampling

The objectives of the background soil sampling were to:

- Characterize the typical background concentrations of chemical constituents in soils in the surrounding industrial area; and
- Characterize the typical background concentrations of chemical constituents in soils in local areas thought to be unaffected by industrial activities. These locations were selected by the U.S. EPA.

Eight background soil samples (BS-01 through BS-08) were collected from the locations shown on Figure 2.2-2. At each location, a sample was collected from 2 to 4 feet in depth. The samples were collected using hollow stem auger drilling techniques and split-spoon barrel sampling techniques. The procedures used for soil boring advancement, equipment decontamination, soil cuttings disposal, logging, soil classification, surveying, geologic and analytical soil sample collection and handling, and field screening are described in detail in Section 3.5 of the October 1991 FSP. In some cases, where the volume of soil in the split-spoon barrel was not sufficient to fill all of the sample containers, it was necessary to collect soil from the auger flight as well as from the split-spoon barrel. The logs for the borings are in Appendix C. The field screening results for the samples are summarized in Table 2.2-1 and on the logs in Appendix C. Survey notes are in Appendix B.

Each background soil sample was analyzed for the full-scan target compounds. The analytical methods used and the quality control sampling plan that was followed are described in detail in the October 1991 QAPP. The analytical results are presented in Tables 2.2-9 through 2.2-12. The tables report the data for the project specific parameters listed in Tables 3.4-3 and 3.4-4 of the QAPP. Extra parameters that were analyzed by the laboratory are included in the laboratory analytical data packages in Appendix D.

2.2.1.3 Surficial Soil Sampling

In order to characterize surficial soil quality across the site, a series of 17 shallow soil samples (SS-01 through SS-17) were collected at the locations shown on Figure 2.2-3. The locations were selected to address areas of the site where potential source areas had not been identified and where other sampling efforts had not been completed. At each location, a sample was collected from 2 to 4 feet in depth. The samples were collected using hollow stem auger drilling techniques and split-spoon barrel sampling techniques. The procedures used for soil boring advancement, equipment decontamination, soil cuttings disposal, logging, soil classification, surveying, geologic and analytical soil sample collection and handling, and field screening are described in detail in Section 3.5 of the October 1991 FSP. In some cases, where the volume of soil in the split-spoon barrel was not sufficient to fill all of the sample containers, it was necessary to collect soil from the auger flight as well as from the split-spoon barrel. The logs for the borings are in Appendix C. The field screening results for the samples are summarized in Table 2.2-1 and on the logs in Appendix C. Survey notes are in Appendix B.

Each surficial soil sample was analyzed for the full-scan target compounds. The analytical methods used and the quality control sampling plan that was followed are described in detail in the October 1991 QAPP. The analytical results are presented in Tables 2.2-13 through 2.2-16. The tables report the data for the project specific parameters listed in Tables 3.4-3 and 3.4-4 of the QAPP. Extra parameters that were analyzed by the laboratory are included in the laboratory analytical data packages in Appendix D.

2.2.1.4 Pilot Borings

The objectives of the pilot borings were to:

- Obtain soil samples for soil description and stratigraphic interpretation;
- Provide geologic information that aided in the design of the monitoring wells; and
- Obtain soil samples for laboratory analysis if field screening results indicated contamination.

Four pilot borings (SB-03 through SB-06) were placed at the site at the locations shown on Figure 2.2-4. Three pilot borings (SB-04 through SB-06) were advanced to the top of the gray silt and clay till at final depths ranging from 27 to 32 feet. One pilot boring (SB-03) was advanced through the till to the top of bedrock at a final depth of 109 feet. Pilot Borings SB-04 through SB-06 were advanced using 6½-inch (inner diameter) hollow-stem auger drilling techniques. Monitoring wells were installed in all pilot borings except SB-03.

Pilot Boring SB-03 was advanced to approximately 6 feet using hollow-stem auger. A 4-inch casing was installed and the boring was continued using mud rotary. At approximately 12 feet, the borehole collapsed. The casing was extended to 20 feet below grade and the boring was continued using mud rotary to completion at 109 feet below grade. The casing was not seated into the clay unit, potentially allowing the drilling fluid that circulated throughout the borehole to contact contaminated groundwater in the zone immediately above the till.

The soil samples collected from Pilot Boring SB-03 were not screened for methane, due to the lack of an activated charcoal filter. The headspace readings noted on the log for Pilot Boring SB-03 and Table 2.2-1 reflect the total headspace concentrations, i.e., including methane, as well as other organic vapors. A significant portion of the headspace readings is believed to be methane. Pilot Boring MW-3D, adjacent to SB-03, had a total headspace

reading of 820 ppm at 26 to 28 feet, but only 160 ppm when adjusted for methane. Elevated headspace readings were seen within the upper clay unit at sampling interval 44 to 46 feet. The headspace concentrations were likely due to the presence of volatile organic compounds in the drilling fluid. Boring SB-03 was abandoned with tremied neat cement grout upon completion.

The procedures used for soil boring advancement, equipment decontamination, soil cuttings disposal, logging, soil classification, surveying, geologic and analytical soil sample collection and handling, and field screening are described in detail in Section 3.5 of the October 1991 FSP. The logs for the borings are in Appendix C. The field screening results for the samples are summarized in Table 2.2-1 and on the logs in Appendix C. Survey notes are in Appendix B.

Soil samples from the borings were submitted for laboratory analysis if field screening results indicated soil contamination. Samples that were submitted for laboratory analysis are listed in Table 2.2-2 and are marked on the soil boring logs in Appendix C. (Because of the use of drilling mud at Pilot Boring SB-03, the sample submitted for laboratory analysis was collected from the hollow stem auger borehole for Monitoring Well MW-3D instead of from Pilot Boring SB-03. For this reason, the sample is identified as MW-3D instead of SB-03-01.) These samples were analyzed for VOCs, PAHs, and phenolic compounds. The analytical methods used and the quality control sampling plan that was followed are described in detail in the October 1991 QAPP. The analytical results are presented in Tables 2.2-17 and 2.2-18. The tables report the data for the project specific parameters listed in Tables 3.4-3 and 3.4-4 of the QAPP. Extra parameters that were analyzed by the laboratory are included in the laboratory analytical data packages in Appendix D.

2.2.2 Hydrogeologic Investigation

The Phase I hydrogeologic investigation consisted of monitoring well and piezometer installation, monitoring well and piezometer surveying, water level measurements, and permeability testing. Investigation objectives and methods are described below.

2.2.2.1 Monitoring Well/Piezometer Installation

The objective of the installation of monitoring wells and piezometers in Phase I was to make a preliminary characterization of groundwater quality and flow directions at the water table and at the base of the surficial sand aquifer at the site. Four water table Monitoring Wells (MW-3S, MW-4S, MW-5S, and MW-6S), four deeper Monitoring Wells (MW-3D, MW-4D, MW-5D, and MW-6D), and four piezometers (P-101 through P-104) were installed at the locations shown on Figure 2.2-4. Monitoring Wells MW-3S and MW-3D and Piezometers P-103 and P-104 were located to provide data for defining the groundwater divide that was expected to be present near the center of the site. Additionally, Wells MW-3S and MW-3D were thought to be located upgradient of the site. The perimeter monitoring wells were positioned to act as monitoring points at the site boundaries and, in conjunction with the piezometers, to provide site-wide coverage for groundwater elevation measurements. The shallow monitoring wells were nested with deeper wells that were screened at the base of the surficial sand aquifer.

The monitoring wells and piezometers were constructed and developed as described in Sections 3.7.3 and 3.7.4 of the October 1991 FSP, except that neat cement grout was used instead of concrete grout in the top 3 feet of the borehole annulus. Monitoring well risers were constructed of 2-inch diameter stainless-steel casing. Piezometer risers were constructed of 1-inch diameter PVC. The water table wells and piezometers were constructed with 10-foot long screens that intersect the water table. The screens were of the same material as the riser. Well construction methods for the water table wells and piezometers were designed to account for the shallow water table. The deeper wells were constructed with 5-foot long stainless steel screens. Well installation was performed using 6½-inch (inner diameter) hollow stem auger drilling techniques. Well construction details are summarized in Table 2.2-19. The monitoring well and piezometer construction logs are in Appendix E.

The monitoring wells were developed as described in Section 3.7.4 of the October 1991 FSP. The development water was treated on-site using a system consisting of two 55-gallon capacity granular-activated carbon adsorbers. The groundwater was containerized at the well location, transported to the treatment

area, and pumped into a holding tank. From the holding tank, the groundwater was moved through the treatment unit and discharged to the ground near Test Trench TT-03. Well development stabilization sheets are in Appendix F.

2.2.2.2 Survey of Monitoring Wells/Piezometers

The elevations at the top of casing and the ground level at each existing and newly installed monitoring well and piezometer were surveyed and tied into a common mean sea level datum. The casing and riser elevations were surveyed to the nearest 0.01 foot, and the ground elevation was surveyed to the nearest 0.1 foot. The well and piezometer locations were also tied into the site coordinate system. The horizontal locations with respect to the site grid are intended to be accurate to within 1 foot. Top of casing and ground elevations are summarized in Table 2.2-19. Survey notes are in Appendix B.

2.2.2.3 Water Level Measurements

Water levels were measured in all on-site monitoring wells and piezometers to provide information on hydraulic gradients and groundwater flow directions. The information was used to develop a preliminary model of groundwater flow at the site. Measurements were made in the wells and piezometers on the following dates in 1992: April 7, April 9, April 15, April 21, May 7, and May 27. Water levels were measured in Waukegan Harbor on April 15, April 21, May 7, and May 27. The procedures and equipment used to make water level measurements are described in Section 3.8 of the October 1991 FSP. Water level measurements are summarized in Table 2.2-20. Water level data sheets are in Appendix F. Water level contour maps for all but the April 19 and April 21 measurement events are presented on Figures 2.2-5 through 2.2-9.

2.2.2.4 Hydraulic Conductivity Testing

The hydraulic conductivity of the surficial sand aquifer at the site was estimated using slug tests. Two slug-out tests were performed at each of the water table monitoring wells. Two slug-in and slug-out tests were performed at each of the deep monitoring wells. Equipment used consisted of a pressure transducer rated at 10 or 20 psi, an automatic data recorder (In Situ Hermit

ST1000B), and a solid PVC plug lowered on a stainless-steel cable. The tests were conducted in the following manner:

1. Measure the water level.
2. Place a pressure transducer greater than 6 but less than 12 feet below the water surface and secure.
3. Set the static water level registered on the data logger as the reference point.
4. Simultaneously activate the data logger's recording mode and lower the slug as rapidly as possible until it is completely below the static water level.
5. Monitor the automatic data logger until the water level returns to the static level.
6. Simultaneously step the data logger to the second step of the test and remove the slug as rapidly as possible.
7. Continue the test until the static water level equilibrates.
8. Stop recording data.
9. Repeat steps 3 through 8 for the second slug test.
10. Decontaminate the pressure transducer, slug, and drop line by washing them in a solution of tap water and detergent and rinsing them in tap water before moving to the next well.

The transducers were connected to the data loggers to record the water level fluctuations during the tests. The recovery of the water in the well after a slug-in or slug-out phase was recorded by the pressure change at the transducer at logarithmic time intervals. Recovery was achieved after a few minutes.

Slug test data were analyzed using the Bouwer and Rice method (Bouwer and Rice, 1976; Bouwer, 1989). To perform this analysis, the digitally recorded data were downloaded to a computer and the time versus drawdown data were plotted with the use of AQTESOLV software (Duffield and Rumbaugh, 1989). The AQTESOLV plots are in Appendix G. The portion of the curve thought to represent the response from the aquifer was determined visually. The appropriate time-drawdown points were selected from this portion of the curve for use in the analytical solution for hydraulic conductivity. The wells were assumed to be partially penetrating. Also, slug-in data was not analyzed for the wells in which the screen intersects the water table because the data obtained from the slug-in or wetting phase of the test are not representative of saturated conditions and violate the assumptions of the Bouwer and Rice method. The parameters used in the analyses are summarized in Table G-1 in Appendix G. Hydraulic conductivity estimates based on the slug test results are summarized in Table 2.2-21.

2.2.3 Groundwater Quality Investigation

The Phase I groundwater quality investigation consisted of one groundwater sampling event. Investigation objectives and methods are described below.

The objectives of the Phase I groundwater quality sampling were to:

- Determine the nature and extent of groundwater contamination at the selected locations along the site perimeter;
- Evaluate the spatial distribution of contaminants in the groundwater;
- Collect sufficient data to determine whether or not the site poses a threat to potential downgradient receptors;
- Check for contaminants in the groundwater that are not the result of manufactured gas/coking plant or creosoting processes; and

- Assist in the preliminary selection of possible remedial alternatives.

Samples were collected from all on-site monitoring wells on April 7 through April 9, 1992. The procedures and equipment used for monitoring well preparation, well stabilization, sample collection, and sampling handling are described in detail in Section 3.9 of the October 1991 FSP and Section 6.4 of the October 1991 QAPP. The field log data sheets for the Phase I sampling event are in Appendix H.

The groundwater samples were analyzed for semivolatiles, VOCs, cyanide, dissolved metals, pesticides, and PCBs. The analytical methods are described in detail in the QAPP. The analytical results are in Tables 2.2-22 through 2.2-29.

2.2.4 Ecological Survey Methods

An ecological survey of the site and surrounding area was conducted as part of the Phase I field investigation. Data collection activities for this task consisted of: a review of available ecological studies, sediment and surface water data and aerial photographs; additional information requested from state and local natural resource agencies; and a site reconnaissance.

2.3 QUALITY ASSURANCE/QUALITY CONTROL REVIEW SUMMARY

2.3.1 Introduction

A review of quality control data was conducted to assess the integrity of the sampling procedures and analytical results from samples collected during March and April 1992 at the WCP site. The quality control procedures followed during collection and analysis of the samples are discussed in the October 1991 QAPP. Internal and external quality control procedures used during the collection and analysis of samples are discussed in the following sections.

2.3.2 Quality Control Procedures

Internal quality control included initial and ongoing programs of quality assurance performed by CH₂M Hill Analytical Laboratory in accordance with their laboratory QAPP. External Quality control involved the collection and analysis of field blanks, trip blanks, and matrix spike and matrix spike duplicate samples.

CH₂M Hill analyzed the samples using gas chromatography according to the U.S. EPA Contract Laboratory Program (CLP) Statement of Work (SOW). The results were reviewed following the U.S. EPA Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses, and Inorganic Analyses (U.S. EPA, 1988).

2.3.3 Data Validation

Data validation included reviewing the following items: holding times, instrument tuning, calibration, blank samples, surrogate recoveries, and matrix spike/matrix spike duplicate samples, interference check samples, laboratory control samples, and serial dilution samples.

Method blanks are clean sample equivalents composed of distilled, deionized water that are processed and analyzed as a sample to determine the existence and magnitude of potential contamination introduced during sample preparation and analysis.

Field blank samples are collected to identify contamination from improper decontamination, sampling procedures, bottle transport, and laboratory procedures.

Trip blank samples are used to indicate potential contamination due to migration of volatile organic chemicals from the sample shipping containers during sample transport, from the sample containers themselves or the analyte free water provided by the laboratory.

Both field and laboratory duplicate samples are analyzed to determine data precision, a measure of the reproducibility of field sampling and laboratory analysis. The results are reported as Relative Percent Difference (RPD) and calculated by:

$$RPD = \frac{S - D}{(S + D)/2} \times 100$$

where:

S = concentration of sample

D = concentration of duplicate sample

A "surrogate spike" in organic analysis is a compound not expected to be present in environmental samples, but with properties similar to those of the target compounds. It is added to all samples before extraction and other sample preparation. It is measured by the percent recovery. Percent recovery (%R) is calculated by:

$$\%R = (SSR/SA) \times 100$$

where:

SSR = quantity measured in spiked sample

SA = quantity of spike added

A "matrix spike" consists of target compounds added to a sample just before analysis. It is performed to evaluate matrix effects on the analytical methodology and data accuracy. Percent recovery for a matrix spike is calculated by:

$$\%R = \frac{SSR-SR}{SA} \times 100$$

where:

SR = quantity measured in unspiked sample

For inorganic inductively coupled plasma (ICP) analysis, a serial dilution is done for each set of samples of similar matrix type and concentration. For

an analyte concentration at least a factor of 50 above the instrument detection limit (IDL), the measured concentrations of the undiluted sample and of the sample after a five-fold dilution should agree within 10 percent. If the difference is greater than 10 percent, the results for that compound are considered estimated because of matrix interference.

The pesticide/PCB quality control evaluation was limited to a review of the laboratory case narrative and the quality control data summary forms.

Eighty-six samples were collected during March and April, 1992. These samples were analyzed by CH₂M Hill Analytical Laboratory for inorganics, volatiles, semivolatiles, PAH and phenolic, and pesticides and PCB parameters. Two samples (TT0604 and TT0604 duplicate) were analyzed for TCLP volatiles and TCLP semivolatiles parameters. These TCLP data were reviewed for compliance with the Chain-of-Custody form and holding times only because TCLP analysis is not a CLP method and no other quality control data were provided. No difficulties were encountered.

Sample results for the TCLP parameters are summarized in Table 2.2-8. Field duplicate results are shown in Table 2.3-11.

Overall Assessment -- All sample data were considered acceptable with the recommended qualifiers except "R" qualified data. The "R" qualifier is used to designate data which is unusable. Antimony results were "R" qualified in samples SS01, SS06, SS07, SS08, SS09, SS11, SS12, SS14, T03W02 and TT1402 and cyanide results were "R" qualified in samples BS07 and BS08. These samples had spike sample recoveries for antimony and cyanide that were less than 30 percent. According to CLP guidelines, these data must be qualified as unusable.

2.3.4 Sample Results and Quality Control Review

2.3.4.1 Inorganic Constituents

Fifty-six samples (includes field duplicate and field blank samples) were analyzed for low concentration metals. The results for these samples are

presented in Tables 2.2-3, 2.2-9, 2.2-13, 2.2-22, 2.2-26, 2.3-1, and 2.3-6, and are qualified as described in the following sections.

Holding Times -- Holding times were met on all samples (soil and water) and analyses using the U.S. EPA holding time criteria for water samples.

Instrument Calibration -- Instrument calibrations were completed the proper number of times using the appropriate number and type of standards and blanks. Initial and continuing calibration percent recovery values were acceptable for all metals analyses.

Blanks -- Metals analyses calibration, preparation, and field blanks had concentrations of several compounds less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL). Sample results less than five times the blank concentration were qualified as nondetects and flagged "U." Results for blank samples are shown in Table 2.3-1.

ICP Interference Check Sample -- Metals analyses ICP interference check sample recoveries were within the established quality control limits.

Laboratory Control Sample -- Metals analyses laboratory control sample results were within the established quality control limits.

Duplicate Sample -- Duplicate sample RPD values for beryllium, cadmium, copper, chromium, cyanide, lead, manganese, mercury, selenium, sodium, thallium, and zinc were beyond the appropriate control limits. Results for these outlier compounds in the affected samples were qualified as estimated and flagged "J."

Duplicate sample results for sample T03W01 were in report 21171. This report was for another CH₂M Hill client and was not received. The data were accepted without a duplicate sample review.

Spike Sample -- Recoveries for the spike samples were beyond control limits for antimony, arsenic, cadmium, cyanide, lead, manganese, and selenium. Associated sample results for Antimony or cyanide at concentrations less than the IDL were qualified as unusable and flagged "R." Antimony or cyanide results

greater than the IDL were qualified as estimated and flagged "J." Results for the remaining outlier compounds in the associated investigative samples were qualified as estimated and flagged "J."

Spike sample results for sample T03W01 were in report 21171. This report was for another CH₂M Hill client and was not received. The data were accepted without a spike sample review.

Post Digestion Spike Sample -- Arsenic, lead, selenium, and thallium recoveries for several post digestion spike samples were beyond the established control limits. These compounds were qualified as estimated and flagged "J" in the affected samples.

ICP Serial Dilution -- ICP Serial Dilution results for aluminum, barium, cobalt, iron, potassium, sodium, and zinc were beyond control limits. These compounds were qualified as estimated and flagged "J" in the associated samples.

Field Duplicates -- Field duplicates are summarized in Table 2.3-6.

Overall Assessment -- All sample data were considered acceptable with the recommended qualifiers except "R" qualified data. Antimony results were "R" qualified in samples SS01, SS06, SS07, SS08, SS09, SS11, SS12, SS14, T03W02 and TT1402. Cyanide results were "R" qualified in samples BS07 and BS08. These samples had spike sample recoveries for antimony and cyanide that were less than 30 percent. According to CLP guidelines, these data must be qualified as unusable. This data is unusable.

2.3.4.2 Volatile Organic Compounds

Seventy-nine investigative samples (includes field duplicate, field blank, and trip blank samples) were analyzed for low concentration volatile organic compounds. The results for these samples are presented in Tables 2.2-4, 2.2-10, 2.2-14, 2.2-17, 2.2-23, 2.2-27, 2.3-2, and 2.3-7, and are qualified as described in the following sections.

Holding Times -- Holding times were met on all samples (soil and water) and analyses using the U.S. EPA holding time criteria for water samples.

Instrument Tuning -- GC/MS Tuning met the established method performance criteria for compounds, concentrations, frequencies and relative ion abundances for the volatiles analyses.

Instrument Calibration -- Initial calibration percent relative standard deviation (%RSD) and continuing calibration percent difference (%D) values for several volatile parameters were outside of the appropriate control limits. Control limits for %RSD and %D were ≤ 30 percent and ≤ 25 percent, respectively.

The volatiles analyses initial calibration parameters and %RSD values beyond control limits were 2-butanone, acetone, bromodichloromethane, chloroethane, and chloromethane. Parameters with %D outlier values were target compounds 1,1-dichloroethane, 1,1,1-trichloroethane, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, bromoform, bromomethane, carbon disulfide, chloroethane, chloromethane, methylene chloride, vinyl chloride, and the surrogate standard 1,2-dichloroethane-d4. Positive sample results associated with the outlier compounds were qualified as estimated and flagged "J."

Blanks -- Acetone, chloroform, methylene chloride, and 2-butanone were detected in the volatiles blanks. Associated sample results less than five times the blank concentration of chloroform or 2-butanone were qualified as nondetects and flagged "U." Associated sample results less than ten times the blank concentration of acetone or methylene chloride were qualified as nondetects and flagged "U." Results for blank samples are shown in Table 2.3-2.

Surrogate Recovery -- Recoveries for the volatiles system monitoring compounds bromofluorobenzene, toluene-d8, and 1,2-dichloroethane-d4 were beyond control limits for several samples. Positive sample results affected by these outliers were qualified as estimated and flagged "J."

Matrix Spike/Matrix Spike Duplicate -- Volatiles analyses matrix spike/matrix spike duplicate samples percent recovery values for benzene and toluene were beyond control limits. The RPD values for benzene and toluene were also

outside the appropriate control limits. Affected sample results for these compounds were qualified as estimated and flagged "J" or "UJ."

Matrix spike/matrix spike duplicate results for sample TT1001 were included in a laboratory report for another CH₂M Hill client. The results for this sample were accepted without the matrix spike samples review.

Field Duplicates -- Field duplicates are summarized in Table 2.3-7.

Overall Assessment -- The data are considered acceptable with the recommended qualifiers.

2.3.4.3 Semivolatile Organic Compounds

Fifty-one samples were analyzed for low concentration semivolatile organic compounds, and 25 samples were analyzed for PAH and phenolic compounds (includes field duplicate and field blank samples). The results for these samples are presented in Tables 2.2-5, 2.2-6, 2.2-11, 2.2-15, 2.2-18, 2.2-24, 2.2-28, 2.3-3, 2.3-4, 2.3-8, and 2.3-9, and are qualified as described in the following sections.

Holding Times -- Holding times were met on all samples (soil and water) and analyses using the U.S. EPA holding time criteria for water samples.

Instrument Tuning -- GC/MS Tuning met the established method performance criteria for compounds, concentrations, frequencies, and relative ion abundances for the semivolatiles analyses.

Instrument Calibration -- Initial calibration percent relative standard deviation (%RSD) and continuing calibration percent difference (%D) values for several semivolatile parameters were outside of the appropriate control limits. Control limits for %RSD and %D were ≤ 30 percent and ≤ 25 percent, respectively.

The semivolatiles analyses that had initial calibration parameters and %RSD values beyond control limits were 2,4-dinitrophenol and the surrogate standard 1,2-dichlorobenzene-d₄. Continuing calibration parameters with %D outlier

values were target compounds 1,2-dichlorobenzene, 2-nitroaniline, 2,2'-oxybis(1-chloropropane), 2,4-dinitrophenol, 3,3-dichlorobenzidine, 4-chlorophenyl-phenyl-ether, 4-nitrophenol, 4,6-dinitro-2-methylphenol, benzo(b)fluoranthene, benzo(g,h,i)perylene, butylbenzylphthalate, bis(2-chloroethyl)ether, di-n-octylphthalate, hexachlorocyclopentadiene, n-nitroso-di-n-propylamine, pentachlorophenol, phenol, and the surrogate standards 1,2-dichlorobenzene-d4 and 2,4,6-tribromophenol. Positive sample results associated with the outlier compounds were qualified as estimated and flagged "J."

Blanks -- The semivolatiles blanks had concentrations of bis(2-ethylhexyl)phthalate, di-n-butylphthalate, phenol, and 4-methylphenol. Associated sample results less than five times the blank concentration of phenol or 4-ethylphenol were qualified as nondetects and flagged "U." Associated sample results less than ten times the blank concentration of bis(2-ethylhexyl)phthalate or di-n-butylphthalate were qualified as nondetects and flagged "U." Results for blank samples are shown in Tables 2.3-3 and 2.3-4.

Surrogate Recovery -- Surrogate recoveries could not be determined on several samples due to the large dilutions required for analysis. No data were qualified.

Matrix Spike/Matrix Spike Duplicate -- Semivolatiles analyses matrix spike/matrix spike duplicate samples had recoveries beyond control limits for 1,2,4-trichlorobenzene, 2,4-dinitrotoluene, acenaphthene, and phenol. RPD values for acenaphthene, phenol, and pyrene were also beyond control limits. Since recoveries for these compounds were within control limits for the corresponding Matrix spike or matrix spike duplicate sample and no other difficulties were encountered with these compounds, no action was taken.

Another matrix spike/matrix spike duplicate sample had recoveries beyond control limits for phenol and outlier RPD values outside of control limits for phenol and naphthalene. Recoveries for naphthalene were acceptable so no further action was taken. Phenol results in the affected samples were qualified as estimated and flagged "J."

PAH/phenol analyses matrix spike/matrix spike duplicate samples had several compounds with recoveries and RPD values outside the control limits. These results may be due to the high level of spike compounds in the native sample so no data were qualified.

Field Duplicates -- Field duplicates are summarized in Tables 2.3-8 and 2.3-9.

Overall Assessment -- The data are considered acceptable with the recommended qualifiers.

2.3.4.4 Pesticides and PCBs

Forty-nine samples (includes field duplicate and field blank samples) were analyzed for low concentration pesticides and PCBs. The results for these samples are presented in Tables 2.2-7, 2.2-12, 2.2-16, 2.2-25, 2.2-29, 2.3-5, 2.3-10, and are qualified as described in the following sections.

Holding Times -- Holding times were met on all samples (soil and water) and analyses using the U.S. EPA holding time criteria for water samples.

Instrument Tuning -- Decachlorobiphenyl was excessively late for several injections on both GC columns. As a result, the chromatographic data were interpreted using identification windows wider than usual. Since adequate separation of components was achieved no further action was taken. Instrument performance was acceptable for retention times, retention time windows, and DDT and endrin degradation for all other samples.

Instrument Calibration -- Pesticides/PCB analyses instrument calibration %RSD for methoxychlor exceeded the ≤ 15 percent control limits. Methoxychlor results in the associated samples were qualified as estimated and flagged "J" or "UJ."

Continuing calibrations %D values for all compounds were acceptable. The resolution check mixture and performance evaluation mixture samples were analyzed at the proper frequency. All retention times were in control except

decachlorobiphenyl. The retention time for decachlorobiphenyl was beyond the ± 0.02 minute control limits, but was within the associated retention time window, so no data were qualified. All RPD values were within control limits.

Blanks -- No compounds were detected in the Pesticide/PCB blanks. Results for blank samples are shown in Table 2.3-5.

Surrogate Recovery -- The pesticide/PCB surrogate standards decachlorobiphenyl and tetrachloro-m-xylene could not be determined for several samples due to interferences and the large dilutions required for analysis. A few samples had unacceptably low surrogate recoveries. These sample results were qualified as estimated and flagged "J" or "UJ."

Matrix Spike/Matrix Spike Duplicate -- Pesticide/PCB matrix spike/matrix spike duplicate samples had outlier recoveries for aldrin and outlier RPD values for aldrin, gamma-BHC, and heptachlor. Since aldrin recoveries were acceptable on the Matrix Spike sample, no action was taken. Associated sample results for gamma-BHC and heptachlor were qualified as estimated and flagged "J" or "UJ."

Field Duplicates -- Field duplicates are summarized in Table 2.3-10.

Overall Assessment -- The data are considered acceptable with the recommended qualifiers.

2.4 DISCUSSION OF RESULTS

2.4.1 Geologic Conditions

2.4.1.1 Site Geology

The site is blanketed with fill from the surface to a depth of about 6 feet. This fill is composed of sand with layers of furnace clinkers, coal and coal fines, demolition debris, lean clay, industrial pond deposit, and tar.

Fine to medium sand is present below the fill to a depth of about 30 feet. This sand is generally poorly graded sand (SP) with layers, particularly on the

northwest portion of the site, of poorly graded sand with silt (SP-SM) and silty sand (SM). This deposit is assumed to be lake sediments of the Dolton member of the Equality Formation. Below the sand a higher energy deposit of gravel and silty gravel from a few inches to several feet in thickness overlays glacial till. Figure 2.4-1 shows the locations of geologic cross sections of the site. Figures 2.4-2 and 2.4-3 show the geologic cross sections. The glacial till is a gray silty clay (CL) to silty sand with clay (SM). This till is assumed to be the Wadsworth till member of the Wedron Formation. A contour map of the surface elevation of the till is shown on Figure 2.4-4. The contour map was constructed using information from the soil boring logs for Pilot Borings SB-03 through SB-06 and from the well log for Monitoring Well MW-1D.

Bedrock was encountered in Pilot Boring SB-03 at a depth of 108 feet. Chips of rock recovered were logged as dolomite of the Racine Formation.

2.4.1.2 Site Geomorphology

The WCP site is located on a flat-lying peninsula. The peninsula is bounded to the east by Lake Michigan, and on the south and west by Waukegan Harbor.

Portions of the site and much of the site vicinity were filled and reclaimed in the late 19th and early 20th centuries. Historical maps of the site indicate the eastern half of the site and the current public beach have been deposited since the turn of the century.

2.4.2 Hydrogeologic Conditions

2.4.2.1 Hydrogeologic Characterization

The following characterization of the hydrogeology of the site addresses the unconfined, unconsolidated sand aquifer above the till. This characterization is based on data collected during the Phase I investigation. The data include groundwater elevation measurements and the results of in situ permeability tests (slug tests). In addition, a preliminary computer model of groundwater flow was developed to provide an initial evaluation of groundwater

flow patterns. Results of the modeling were used to provide guidance in locating monitoring wells to be installed during the second phase of the investigation, to identify data gaps to be addressed during the second phase of the investigation, and to design the pumping test to be performed during Phase II.

Groundwater and harbor level elevations measured during the Phase I investigation are summarized in Table 2.2-20. The groundwater elevations measured in the shallow monitoring wells and the piezometers are illustrated on Figures 2.2-5 through 2.2-8. The water level data sheets are in Appendix F.

The groundwater elevation measurements indicate that the water levels decreased approximately 0.7 foot between April 4 and May 27, 1992. The interpretations of groundwater elevation measurements shown on Figures 2.2-5 through 2.2-8 indicate that the groundwater beneath the site is flowing toward the slip and harbor. The highest water level measurements are along the northern and eastern boundaries of the site.

The groundwater elevation contours constructed from groundwater elevation data collected in the shallow monitoring wells and piezometers indicate that the magnitude of the overall horizontal hydraulic gradient in the sand aquifer ranges from 0.0002 feet/foot to 0.0036 feet/foot in the direction of groundwater flow. The magnitude of the horizontal hydraulic gradients increase to an estimated 0.033 feet/foot in the vicinity of the slip.

Vertical hydraulic gradients between the upper and basal portions of the sand aquifer were calculated from groundwater elevation data collected from the well nests MW-1S/MW-1D, MW-3S/MW-3D, MW-4S/MW-4D, MW-5S/MW-5D, and MW-6S/MW-6D. The vertical hydraulic gradients are summarized in Table 2.4-1. The vertical hydraulic gradients in the sand aquifer are small and consistently downward. The magnitude of the gradients range from 0.0008 to 0.0054 feet/foot with the average downward gradient being 0.0029 feet/foot.

Hydraulic gradients between the surficial aquifer and the Silurian bedrock were reported to be in an upward direction (Canonie, 1989). One of the two piezometers installed into the Silurian bedrock reportedly flowed at the

surface. Information on the magnitude of the upward gradient was not included in the Canonie report.

The results of the hydraulic conductivity values estimated from the results of the slug tests are shown in Table 2.2-21. The slug test data and evaluations are in Appendix G. The hydraulic conductivity estimates for the sand aquifer range from 1.1 to 16.3 feet/day (3.9×10^{-4} to 5.8×10^{-3} cm/sec). The geometric mean of the estimates is 5.9 feet/day (2.1×10^{-3} cm/sec). Hydraulic conductivity estimates for the upper and basal portions of the sand aquifer are similar. The hydraulic conductivity estimates are also similar to those reported for the surficial unconsolidated materials at the OMC Plant No. 2 site north of the site (JRB, 1981).

The average linear groundwater velocity of the sand aquifer is estimated to be approximately 0.143 feet/day or 52 feet/year, using the geometric mean of hydraulic conductivity estimates (5.9 feet/day), an average horizontal hydraulic gradient of 0.0073 feet/foot, and an estimated effective porosity of 0.30 for well sorted sand (Fetter, 1988). Using the minimum and maximum values of horizontal hydraulic gradients and the geometric mean of hydraulic conductivity estimates, the expected range of groundwater flow velocities in the sand aquifer is 1.4 feet/year to 240 feet/year.

2.4.2.2 Hydrogeologic Model Development

A preliminary simulation of steady-state groundwater flow in the vicinity of the site was performed using the Single Layer Analytic Element Model (SLAEM). SLAEM was described in the July 1, 1991 Technical Memorandum, Proposed Modeling for RI/FS, Waukegan Manufactured Gas and Coke Plant Site. The preliminary simulation was developed to provide an initial evaluation of long-term groundwater flow patterns, to provide guidance in locating monitoring wells to be installed during the second phase of the investigation, to identify data gaps to be addressed during the second phase of the investigation, and to design the pumping test to be performed during Phase II.

The configuration of hydrogeologic features included in the model and the calibration procedures used in the preliminary simulation are discussed in detail in Appendix I. The data files for the model are also in Appendix I.

The computed potentiometric surface for the preliminary simulation of current site conditions is shown on Figure I-3 in Appendix I. The simulation shows a groundwater mound on-site centered on the peninsula. Predicted groundwater flow is radial towards the ditch and lake from the northern boundary of the site, toward the harbor and slip from most of the site, and toward the lake from the eastern fringe of the site. Groundwater from the southern portion of the site is predicted to be flowing radially to both the lake and harbor.

The groundwater flow patterns predicted by the preliminary model were compared to contour maps of measured groundwater elevations to assess the representativeness of the predicted flow patterns and to help identify data gaps. Groundwater elevation contour maps prepared from measured data are shown on Figures 2.2-5 through 2.2-8. A second, more interpretive groundwater elevation contour map was prepared from the May 7, 1992 measured data to provide an alternative representation of flow patterns for comparison to the model results. This contour map is shown on Figure 2.2-9 and incorporates both the measured groundwater elevation data for May 7, 1992 and conceptual ideas of groundwater flow patterns (as derived from the preliminary model).

The general patterns of groundwater flow that were indicated by results of preliminary modeling indicate a potential for eastward flow from the eastern fringe of the site. This pattern of flow differs from that inferred from the water table elevation contour interpretations shown on Figures 2.2-5 through 2.2-8, which indicate flow toward the southeast from the northeast corner of the site. However, as shown on Figure 2.2-9, the actual water level data are not necessarily inconsistent with the concept of eastward flow from the eastern fringe of the site. In order to more fully assess the representativeness of the groundwater flow patterns predicted by the preliminary model, groundwater elevation measurements from the southern and northeastern portions of the site, as well as from areas north and east of the site, will be necessary. Section 3.3 describes the rationale for the locations of additional monitoring

wells to be installed during the second phase of the investigation to provide data for such an assessment.

The preliminary groundwater flow modeling identified several data gaps to be addressed in the second phase of the investigation. These include the need for: water level measurements on the northeastern and southern portions of the site, as well as north and east of the site to better define groundwater flow patterns; water level measurements in the North Ditch north of OMC Plant No. 2 to better understand the hydraulic connection between the ditch and the aquifer; additional water level measurement events conducted over a longer time period to better understand the nature of variations in groundwater elevations and flow patterns over time; and geologic/hydrogeologic data for zones of varying hydraulic conductivity that may be present within the sand aquifer to assess their extent and hydrogeologic influence. Each of these data needs is addressed in the work plan for the second phase of the investigation.

In addition to being used to assess groundwater flow patterns and identify data gaps, the preliminary model was used to design the pumping test to be conducted during the Phase II investigation. Potential locations for the pumping well to be placed for the pumping test were selected to be:

- Close to an existing monitoring well nest to ensure that measurable drawdowns will occur at a minimum of two observation wells;
- Generally downgradient of potential source areas to provide areally representative data for assessing contaminant transport and potential remedial alternatives; and
- Near, but not adjacent to, a groundwater/surface water interface to potentially provide data for assessing hydraulic communication between the groundwater and surface water systems.

Accordingly, pumping test scenarios in the vicinity of Monitoring Wells MW-1S and MW-1D and Piezometer P-104 were simulated using the transient well feature in SLAEM and a specific storage of 0.01 feet^{-1} . Different pumping well locations (ranging from 15 to 100 feet south and 0 to 120 feet east of

Monitoring Well MW-1S), pumping rates (10 to 25 gpm), and pumping test durations (one to two days) were simulated in an effort to optimize drawdown in the observation wells (MW-1S, MW-1D, P-104) and minimize the amount of water produced. Two scenarios predicted observable drawdowns at Well MW-1S and MW-1D and minimized water production. Each scenario had one pumping well that was pumping at a rate of 15 gpm. In one scenario, the pumping well was located 15 feet south of Well MW-1S. In the other scenario, the pumping well was located 25 feet south of Well MW-1S. The predicted drawdowns for these scenarios after one day of pumping are shown on Figures I-4 and I-5, respectively. None of the simulations confirmed that observable drawdowns would result at Piezometer P-104.

2.4.3 Background Soil Quality Summary

Eight background soil sample locations were identified in the approved RI/FS Final Work Plan. As discussed in Section 2.2.1.2 of this technical memorandum, the objectives of the background soil sampling were to: (1) characterize typical background concentrations of chemical constituents in the surrounding industrial area; and (2) characterize typical background concentrations of chemical constituents in soils in local areas thought to be unaffected by industrial activities.

Background sample locations BS-01 through BS-04 were selected by the U.S. EPA to represent locations thought to be unaffected by industrial activities. These four sample locations were further adjusted by U.S. EPA personnel in the field prior to sampling. Background sample locations BS-05 through BS-08 were selected to characterize soil quality in the surrounding industrial area.

After reviewing laboratory analytical data for the background soil samples, the U.S. EPA indicated that Background Soil Sample BS-03 could not be used to characterize soil quality for areas thought to be unaffected by industrial activities. As a result, data from sample locations BS-01, BS-02, and BS-04 are used in this technical memorandum to represent data from U.S. EPA-designated background sample locations for the purpose of selecting Phase II analytical parameters. Table 2.4-2 shows chemical constituent concentration ranges for

Background Soil Samples BS-01 through BS-08, and for U.S. EPA-designated Background Soil Samples BS-01, BS-02, and BS-04.

2.4.4 On-Site Soil Quality Summary

This section of the technical memorandum presents the soil quality data collected during the Phase I field investigation, summarizes the distribution of PAHs on site, and identifies those chemical parameters that will be part of the Phase II soil sampling program.

Analytical data for the Phase I soil samples are presented in Tables 2.2-3 through 2.2-18. The parameters presented in the tables are the project specific parameters listed in Tables 3.4-3 and 3.4-4 in the October 1991 QAPP. The data tables are first organized by sample type: characterization soil samples, background soil samples, surficial soil samples, and pilot boring samples; and then by parameter group: inorganic parameters, VOCs, semivolatile organic compounds, PAHs, and phenolic compounds, pesticides and PCBs, and TCLP parameters. Laboratory reports and quality control summaries for the soil sample data are in Appendix D.

In order to accurately quantify the concentrations of parameters present in a sample, the laboratory must prepare the sample extract so the concentrations of parameters of interest are in the calibrated range of their analytical instruments. Thus, if any parameter of interest is present at higher concentrations than the upper end of the instrument's calibrated range, the sample must be diluted. Because PAHs and phenols are analyzed together by the same instrument, a high dilution for one group results in a high dilution for the other as well. Any sample with a PAH or phenolic parameter for which the stated quantitation limit is nominally 300 $\mu\text{g/kg}$, but which had a concentration in excess of about 2,640 $\mu\text{g/kg}$, would be expected to require dilution for analysis. The exact upper limit of the calibration range depends on a number of instrument-specific, method-specific, and parameter-specific factors.

The laboratory extends the range of reported concentrations by also reporting concentrations below the stated quantitation limit. Many of the concentrations of PAHs, phenolic compounds, and volatile organic compounds are

reported in the data tables at concentrations less than the stated quantitation limit. Such concentrations are qualified with a "J" to indicate that they are estimated values. The laboratory is able to report this data because the laboratory's detection limit is lower than the stated quantitation limit. If, during laboratory analysis, minimum area counts and correct ion fraction ratios have been achieved and background responses are below a threshold level, the laboratory is able to routinely identify parameters and quantify concentrations down to about 10 percent of the stated quantitation limit for VOCs, PAHs, and phenolic compounds. For example, the nominal stated quantitation limit for benzo(a)pyrene is 330 µg/kg, but the laboratory instrumentation and the analytical method routinely allow identification and quantification of benzo(a)pyrene down to 33 µg/kg, as long as background responses do not interfere. Since estimated values (J-coded) are reported for many parameters in the data tables, it is reasonable to conclude that minimum area counts, correct ion fraction ratios, and background responses below threshold levels were achieved for those parameters. Therefore, in cases where no detected concentration is reported in a data table for one of those parameters, it is reasonable to expect that the parameter was not detected at a concentration greater than 10 percent of the quantitation limit shown in the data table.

2.4.4.1 Manufactured Gas and Coke Plant (MGP/Coking) and Creosote Compounds

As discussed in Section 1.4, MGP/coking and wood treating processes may each have resulted in the release of coal tar products and sludges. Both coal tar (associated with MGP/coking operations) and creosote (associated with wood treating operations) are derived from coal, creosote being a blend of coal tar distillates. Therefore, the suite of compounds associated with coal tar is difficult to distinguish from compounds associated with creosote. Neither coal tar nor creosote contains chlorinated compounds or other chemical additives that could readily distinguish the two. However, the relative proportions of various component compounds may allow differentiation between coal tar and creosote, provided that age and degradation have not obscured the distinctions. Historic information on the activities at various locations at the site provides a basis for distinguishing MGP/coking from creosote residuals in this report.

Table 1.4-1 summarizes compounds typically associated with MGP/coking and creosoting operations. The listed PAH compounds, phenolic compounds, and volatile aromatic compounds are expected to be associated with both coal tar and creosote. The inorganic parameters in Table 1.4-1 are typically associated with MGP/coking operations rather than with creosote. The results of soil sample analyses for the parameters listed in Table 1.4-1 are discussed below. Discussions of field/laboratory data correlations and areal distributions of identified compounds follow the analytical results.

Table 2.4-3 lists the MGP/coking and creosote parameters that were frequently detected on site. Although o-cresol, p-cresol, and 2-4-dimethylphenol are listed in Table 2.4-3, only phenol is used in the Phase I technical memorandum as an indicator for the presence of phenolic compounds. Table 2.4-4 summarizes the analytical results for the compounds of interest for each soil sample collected during the Phase I field investigation. For each sample in the table, the compounds of interest are presented as sums of certain compound types: the sum of benzene, ethyl benzene, toluene, and xylenes, the sum of PAHs listed in Table 2.4-3, and the sum of carcinogenic PAHs listed in Table 2.4-3; or as the concentration of specific compounds of interest: phenol, arsenic, and cyanide. The samples are grouped into the following sample types: potential source area investigation samples, background soil samples, surficial soil samples, and pilot boring samples.

It should be noted that in some cases where the total PAH concentrations were very high, the concentrations of the carcinogenic PAHs were masked by high dilution factors. The sums of the carcinogenic PAHs in these cases are listed as none detected (ND) in Table 2.4-4, but because of the very high detection limits for the carcinogenic PAH parameters, these ND designations do not mean that carcinogenic PAHs may not be present in the sample. The analytical results for individual parameters are shown in Tables 2.2-3 through 2.2-18. As noted earlier, it is reasonable to expect that these parameters were not detected at concentrations of about 10 percent of the quantitation limits shown in the data tables.

Correlation Between Laboratory Analytical Data and Field Screening Results

-- The results of the oil sheen tests were compared to the total PAH and

carcinogenic PAH concentrations of samples submitted for laboratory analysis. As shown in Table 2.4.5, heavier sheens corresponded to greater concentrations of total PAHs and total carcinogenic PAHs (cPAH). Moderate to heavy oil sheens corresponded to an average total PAH concentration of 1,500,000 $\mu\text{g/kg}$ and an average total cPAH concentration of 96,000 $\mu\text{g/kg}$. Samples with a trace of oil sheen, such as Surficial Soil Samples SS-08 and SS-14, were observed on the fringes of the moderately to heavily contaminated areas. Trace oil sheens corresponded to an average total PAH concentration of 270,000 $\mu\text{g/kg}$ and an average total cPAH concentration of 67,000 $\mu\text{g/kg}$. Samples exhibiting no oil sheen, such as Surficial Soil Sample SS-17, had an average total PAH concentration of 6,600 $\mu\text{g/kg}$ and an average total cPAH concentration of 3,400 $\mu\text{g/kg}$. Oil sheen test results may, therefore, be used to indicate the magnitude of total PAH concentrations, but not to confirm the absence of specific contaminants. Also, it should be noted that analytical samples and field screening samples may be collected from different intervals within a split-spoon sample. Therefore, while field screening results are generally consistent with laboratory analytical results, they will not in all cases be representative of the soil collected for laboratory analytical testing.

Surficial Soil Sample SS-17 was collected from fill below an asphalt parking area. A trace oil sheen was observed in the sample collected from a depth of 0 to 2 feet, and no oil sheen was observed in the sample collected from a depth of 2 to 4 feet. Laboratory analytical results for the sample from a depth of 2 to 4 feet reported a total PAH concentration of 41,000 $\mu\text{g/kg}$. Elevated PAH concentrations in this sample may be associated with the presence of the overlying asphalt.

Distribution of MGP/Coking and Creosote Compounds -- The approximate lateral distribution of coal tar and creosote believed to be related to MGP/coking and creosoting operations was delineated using the field screening results described above. Areas in which moderate and heavy oil sheens were observed on the samples are shown on Figure 2.4-5. Moderate to heavy oil sheen observations were grouped for soils in three areas of the site: the MGP/coking facility area; the wood treating plant area; and the northeast portion of the site. Each area is discussed below relative to the field screening observations and the results of analyses of corresponding soil samples for chemicals

associated with MGP/coking and creosoting operations (summarized in Table 2.4-4). Results from near-surface soil samples (i.e., samples collected from depths equal to or less than the maximum depth of test trenching) are used as indicators of waste materials potentially associated with the locations of specific site operations.

Wood Treating Plant Area -- Areas of moderate to heavy oil sheen in soils in the vicinity of the former wood treating plant appear to be areally distinct from the MGP/coking facility area, based on observations of relatively unaffected soils in Test Trenches TT-05E and TT-09 and surficial soil sampling locations SS-09 and SS-10. Analyses of near-surface soil samples collected within the delineated area near the former wood treating plant (Figure 2.4-5) showed total PAH concentrations ranging from 8.9 mg/kg to 1,000 mg/kg (Table 2.4-4). Phenol was not reported above detection limits for the analyzed near-surface soil samples. Total benzene, ethyl benzene, toluene, and xylenes (BETX) concentrations ranged from 0.003 to 0.18 mg/kg for these samples.

Previous investigations performed to characterize soil conditions in the area of the new slip (Slip No. 4) were conducted in the general area of the former wood treating plant (Canonie, 1990 and 1991). These investigations included chemical analyses of soil samples collected from depth intervals of 2.5 to 7.0 feet below the ground surface. Results from these shallow samples are used for comparison with the results of analyses of near-surface samples from test trenching during Phase I of the RI/FS. The analytical data from the previous investigations show total PAH concentrations ranging from below detection limits to 25,750 mg/kg for shallow soil samples. Phenol and other phenolic compounds were generally not detected in this group of soil samples. The previous investigations did not include analyses of shallow soil samples for BETX compounds.

MGP/Coking Facility Area -- Soils within the delineated area in the vicinity of the former MGP/coking facilities (Figure 2.4-5) generally showed moderate to heavy oil sheens in the test trenching investigations. Analyses of soil samples collected from this area indicated total PAH concentrations ranging from 0.043 mg/kg to 2,100 mg/kg; one sample showed nondetectable results (Table 2.4-4). Phenol was reported above detected limits for one of eight

analyzed samples at a concentration of 130 mg/kg. Total BETX concentrations for soil samples from this area ranged from below detection limits to 600 mg/kg, with the higher BETX results generally reported for samples showing elevated PAH concentrations.

Northeast Portion of the Site -- Soils in the northeast portion of the site showed moderate oil sheens over the areas delineated on Figure 2.4-5. The area is interpreted to be consistent with the former location of ponded water during MGP/coking operations. Analytical data for soil samples from this area showed total PAH concentrations ranging from 0.043 mg/kg to 5,000 mg/kg (Table 2.4-4). Phenol was reported above detection limits in three of six analyzed samples at concentrations ranging from 0.29 to 41 mg/kg. Reported total BETX concentrations ranged from below detection limits to 480 mg/kg for soil samples from the delineated area.

Distribution of Arsenic and Cyanide -- Six samples from the former MGP/coking facility area, one sample from the former wood treating plant area, and all surficial soil samples were submitted for analysis of arsenic. Arsenic concentrations exceeded the U.S. EPA-designated background of 1.7 mg/kg to 2.0 mg/kg (Table 2.4-2) in all but eight of these samples. In the vicinity of the former thionizer building, sulfur pile, and ponding areas in the former MGP/coking facility area, arsenic concentrations ranged from 236 mg/kg to 1,820 mg/kg. The highest concentration was observed in the area of the former sulfur pile. Arsenic concentrations in the production area of the former MGP/coking facility, the former wood treating area, and in all of the surficial soil samples ranged from less than 0.6 to 91.5 mg/kg.

Six soil samples from the former MGP/coking facility area were submitted for analysis of cyanide. The cyanide concentrations of these samples ranged from 2.5 mg/kg to 956 mg/kg. All of these concentrations were above the maximum U.S. EPA-designated background concentration of 0.19 mg/kg.

2.4.4.2 Other Compounds

Other Inorganic Parameters -- The background soil samples, the surficial soil samples, and several of the potential source area investigation samples were analyzed for several other inorganic parameters in addition to arsenic and cyanide. These parameters are listed in Table 3.4-4 of the October 1991 QAPP. The analytical data for these samples are summarized in Tables 2.2-3, 2.2-9, and 2.2-13.

The concentrations of these inorganic parameters in the surficial soil samples and potential source area investigation samples were compared to the concentration ranges of these parameters in the U.S. EPA-designated background soil samples (BS-01, BS-02, and BS-04) and to the concentration ranges of these parameters in natural soils in the United States. (According to the Illinois Geological Survey, concentrations specific to Illinois soils are not available.) Table 2.4-2 summarizes the background concentrations, and Table 2.4-6 summarizes the natural concentrations of these inorganic compounds. For each parameter, the lowest of the upper-range concentration reported for naturally occurring soils was used for comparison. All of these compounds except silver were detected above U.S. EPA-designated background concentrations in one or more samples. Of these parameters, only antimony, mercury, magnesium, and selenium were detected at concentrations greater than the range of naturally occurring concentrations. Antimony, mercury, and magnesium were each detected above the naturally occurring concentration range in only one sample. Selenium was detected in four samples at a concentration greater than naturally occurring concentrations.

In the soil sampling study performed on site by the Illinois Environmental Protection Agency (IEPA) in June 1989, mercury was detected at concentrations of up to 58.0 mg/kg. The IEPA study included the collection and analysis of ten soil samples from seven on-site locations and one soil sample from one off-site location. The samples were collected between 0 and 6 feet in depth. The sampling locations and analytical results for the IEPA study are in Appendix J. Four of the on-site IEPA samples were collected near the by-products recovery area and had mercury concentrations of 0.1 to 18.2 mg/kg. One of the IEPA samples was taken in the gas production area. No mercury was detected in that

sample. Four IEPA samples were collected from the northeast area of the site in the area of the former ponds and had mercury concentrations of 0.2 to 58 mg/kg. One IEPA sample was collected from the northwest part of the site. No mercury was detected in that sample. Mercury was not detected in most site soil samples collected during the Phase I investigation. Mercury was reported above naturally occurring concentrations in only one sample (TT-07-01). This sample was from the by-products recovery area. The concentration of mercury in this sample, 5.6 mg/kg, was qualified as an estimated value due to quality control problems. The IEPA and Phase I soil quality data for mercury suggest that mercury is present at concentrations above naturally occurring concentrations in shallow soil in the northeast corner of the site and in the by-products recovery area.

Inorganic parameters other than arsenic and cyanide do not appear to be contaminants of concern on-site. Further investigation is required to assess whether or not selenium and mercury may be contaminants of concern in specific areas at the site.

Other Volatile Organic Compounds -- All of the background soil samples, surficial soil samples, and pilot boring soil samples, and several of the potential source area investigation samples were submitted for analysis of volatile organic compounds listed in Table 3.4-4 of the October 1991 QAPP. The analytical data for these samples are in Tables 2.2-4, 2.2-10, 2.2-14, and 2.2-17. Volatile organic compounds other than benzene, ethyl benzene, toluene, and xylenes (BETX) that were detected in these soil samples are listed in Table 2.4-7. The table shows the frequency of detection and maximum concentration of each parameter for each sample type. Except for the few detections of chlorinated volatile organic compounds, most non-BETX volatile organic compounds were detected in samples in which BETX compounds were also detected. Chlorinated volatile organic compounds were detected infrequently and at very low concentrations (Table 2.4-7). These compounds are not associated with coal tar or creosote.

Other Semivolatile Organic Compounds -- All of the background soil samples and surficial soil samples and several of the potential source area investigation soil samples were analyzed for the semivolatile organic compounds

listed in Table 3.4-4 in the QAPP. Several test trench samples and all of the pilot boring samples were analyzed for the PAH and phenolic compounds listed in Table 3.4-3 of the QAPP. Analytical results for these samples are shown in Tables 2.2-5, 2.2-6, 2.2-11, 2.2-15, and 2.2-18. Compounds other than phenol and the PAHs discussed above that were detected in these samples were o-cresol, p-cresol, 2,4-dimethylphenol, 4-nitrophenol, pentachlorophenol, carbazole, and bis(2-ethylhexyl)phthalate. Carbazole and bis(2-ethylhexyl)phthalate were the only compounds that were detected frequently and all of the compounds were detected in association with phenol and the MGP/coking and creosote PAHs discussed above.

Pesticides/PCBs -- Six potential source area investigation samples and all of the background and surficial soil samples were analyzed for the pesticides and PCBs listed in Table 3.4-4 of the October 1991 QAPP. The analytical data is presented in Tables 2.2-7, 2.2-12, and 2.2-16. Low levels (up to 31 $\mu\text{g}/\text{kg}$) of certain pesticides were detected in the sample and duplicate sample from background soil sample location BS-06. Pesticides were not detected on-site. PCB-1248 was detected at concentrations of up to 23,000 $\mu\text{g}/\text{kg}$ in Background Soil Samples BS-03 and BS-04. PCB-1260 was detected at concentrations of up to 850 $\mu\text{g}/\text{kg}$ in Background Soil Samples BS-03, BS-04, BS-07, and BS-08. PCB-1248 was detected in on-site Surficial Soil Samples SS-01, SS-03, SS-05, and SS-16 at concentrations less than those of background samples (790 $\mu\text{g}/\text{kg}$ or less). Pesticides and PCBs do not appear to be contaminants of concern on site.

2.4.4.3 Coal Layer

One sample (TT-06-04) from the coal layer in the vicinity of the former wood treating plant was submitted for analysis of inorganics, VOCs, semivolatiles, pesticides and PCBs, and TCLP. The results of these analyses are in Tables 2.2-3, 2.2-4, 2.2-5, 2.2-7, and 2.2-8, respectively. Field screening results for this sample are in Table 2.2-1. No oil sheen or odor was observed for this sample. The nonmethane headspace concentration for the sample was very low (0.5 ppm). Beryllium, cobalt, and selenium were the only inorganic parameters detected above background levels. Their concentrations were low (less than 15 mg/kg). Volatile organic compounds, phenolic compounds, pesticides, and PCBs were not detected in the sample. The total PAH

concentration of the sample was less than 0.001 percent of the sample weight and can be attributed to the chemical make-up of the coal itself. Bituminous coal, the type used for coal carbonization and coking, may be expected to contain 65 to 80 percent aromatic carbon by weight. Of the portion of the bituminous coal likely to be extracted by solvents for laboratory analysis, typically 30 to 50 percent would be aromatic carbon, which would include molecules such as benzene, PAHs, and other aromatic ring-based molecular structures (Elliott, 1981).

Barium and cadmium were the only compounds detected in the TCLP leachate from the sample. Barium was detected at a maximum concentration of 876 $\mu\text{g/L}$. Cadmium was detected at a concentration of 6.3 $\mu\text{g/L}$. The concentrations of both compounds did not exceed their respective regulatory levels (100 mg/L for barium and 1.0 mg/L for cadmium). Accordingly, the coal is not a characteristic waste based on the results of the TCLP analyses.

2.4.4.4 Identification of Phase II Analytical Parameters for Soil

Table 2.4-8 identifies the Phase II analytical parameters that will be used to characterize the nature and extent of chemical constituents in the soils on site. These parameters have been chosen from the more extended list of Phase I parameters. The selection of these parameters is discussed below. Section 3.2 discusses the entire Phase II soil sampling program and all Phase II analytical parameters.

The following rationale was used to select the Phase II soil analytical parameters from the more extended list of Phase I parameters:

1. Parameters that were not detected or not detected above the maximum U.S. EPA-designated background concentrations were removed from the list. This procedure eliminated the following parameters: silver; all volatile organic compounds except methylene chloride, acetone, carbon disulfide, 1,1-dichloroethane, 1,2-dichloroethylene, chloroform, methyl ethyl ketone, 1,1,1-trichloroethane, trichloroethylene, 2-hexanone, styrene, benzene, ethyl benzene, toluene, and xylenes; all phenolic compounds except phenol,

o-cresol, p-cresol, 2,4-dimethylphenol; all pesticides; and all PCBs.

2. Parameters not detected at concentrations exceeding the lowest of the upper-range concentrations for naturally occurring soils were removed from the list. This procedure eliminated the following parameters: aluminum, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, nickel, sodium, thallium, vanadium, and zinc.
3. Parameters that were detected only once or detected above naturally occurring background ranges only once were removed from the list. These parameters were: antimony, magnesium, 1,1-dichloroethane, 1,2-dichloroethylene, 2-hexanone, and pentachlorophenol. 1,1-Dichloroethane and 1,2-dichloroethylene are not associated with MGP/coking or creosote operations. Pentachlorophenol came into use as a wood treating product during the 1930s (Wilkinson, 1979) and, therefore, would not have been used at the former wood treating facility which operated from approximately 1908 to 1912.
4. Parameters that are not associated with MGP/coking or creosote operations and that were detected infrequently (10 percent of samples or less) and at low concentrations (less than 20 $\mu\text{g/kg}$) were also removed from the list. These parameters were chloroform, 1,1,1-trichloroethane, and trichloroethylene.
5. Parameters that are common laboratory contaminants (U.S. EPA, 1988) and/or are not associated with MGP/coking and creosoting operations were removed from the list. These parameters were methylene chloride, acetone, methyl ethyl ketone, and bis(2-ethylhexyl) phthalate.
6. Two parameters were removed from the list because of their lack of typical association with MGP/coking and creosoting operations, their association with detected BETX compounds, and their less frequent detection at lower concentrations (relative to BETX compounds). The

two compounds removed on this basis are styrene and carbon disulfide.

7. One parameter, 4-nitrophenol, was removed from the list because it was detected less frequently than the other phenolic compounds and because toxicity/health-effect data are not available for this parameter.

Those parameters remaining on the list for the Phase II investigation area shown in Table 2.4-8. Cadmium and lead were retained on the list to provide soil quality data for correlation with groundwater quality data collected for these parameters.

2.4.5 Groundwater Quality Summary

Analytical data for Phase I groundwater samples are presented in Tables 2.2-22 through 2.2-29. Analytical parameters are grouped in the tables as follows: inorganic parameters; VOCs; semivolatile organic compounds; and pesticides/PCBs. Tables 2.2-22 through 2.2-25 summarize groundwater quality data for samples from the water table monitoring wells, and analytical data for groundwater samples from the deep monitoring wells are summarized in Tables 2.2-26 through 2.2-29. Occurrences of MGP/coking and creosote compounds and other compounds are summarized in the sections that follow.

In addition to the groundwater sample analyses, water samples were analyzed from the carbon filter treatment unit used to treat development, purge, and decontamination water generated during the Phase I investigation. Water generated from various locations at the site was transported to the treatment unit location, as discussed with the U.S. EPA during implementation of field activities. Samples of the untreated water (influent) and the treated water (effluent) were analyzed for the same parameter list as the groundwater samples. Analytical data for inorganic compounds, volatile organic compounds, semivolatile organic compounds, and pesticides/PCBs in influent/effluent samples are summarized in Tables 2.4-9 through 2.4-12, respectively.

Monitoring Wells were purged prior to sampling and the purge water was handled in the same manner as the development water, i.e., containerized at the well location, transported to the treatment area, and pumped into a holding tank. Influent and effluent samples were collected from the water treatment unit after the purge water from Wells 6D, 1S, and 1D were introduced and mixed in the holding tank. Analytical results indicate higher concentrations of some inorganic compounds in the effluent may be due to either: the carbon having been physically loaded with the inorganics and then releasing the compounds when subsequently flushed with water containing volatile organic compounds; or incomplete mixing in the holding tank, resulting in an influent sample composed primarily of mixed shallow and deep well water, but an effluent sample composed primarily of water collected from the more contaminated deep wells.

2.4.5.1 Distribution of MGP/Coking and Creosote Compounds

Compounds anticipated to be associated with former MGP/coking and creosoting operations at the WCP site are identified in Table 1.4-1. Results of analyses of Phase I groundwater samples for specific MGP/coking and creosote compounds are summarized in Table 2.4-13. The data in Table 2.4-13 show that the following MGP/coking and creosote parameters were detected in a majority of the groundwater samples: benzene, ethyl benzene, toluene, and xylenes (BETX); phenol; arsenic; and cyanide. Although PAHs were reported above detection limits in comparatively fewer groundwater samples (Table 2.4-13), reporting limits for these analyses were raised significantly for those samples with high reported concentrations of phenolic compounds. However, as noted in the soil quality summary discussion, it is reasonable to expect that these compounds were not present at concentrations of about 10 percent of the quantitation limit shown in the data tables. The phenolic concentrations did not adversely affect the detection limits for parameters other than PAHs.

For the one groundwater sample with reported concentrations of carcinogenic PAHs (from Well MW-4S), it is suspected that sediment in the sample may have influenced the results. These groundwater quality data are suspect because the reported benzo(a)pyrene concentration (3 $\mu\text{g/L}$) approaches the solubility limit for this compound (3.8 $\mu\text{g/L}$), despite the fact that no tar or oil was observed in the pilot boring for the well (Boring SB-04). The reported carcinogenic PAH

concentrations may therefore reflect compounds adsorbed on sediment particles collected with the groundwater sample. Monitoring Well MW-4S will be redeveloped prior to Phase II sampling.

Vertical Distribution -- The groundwater quality data summarized in Table 2.4-13 indicate that concentrations of detected organic and inorganic compounds in groundwater are significantly greater for samples from the deep monitoring wells than for samples from the shallow monitoring wells. This trend is observed in the data for BETX, phenol, arsenic, and cyanide. The nondetectable results for PAH analyses of samples from the deep monitoring wells may reflect the higher reporting limits associated with high concentrations of phenolic compounds in these samples.

Horizontal Distribution -- Phase I groundwater analytical data have been plotted at the corresponding sampling locations to assess the horizontal distribution of MGP/coking and creosote compounds. The data are shown on Figures 2.4-6 through 2.4-9 for phenol, total BETX, cyanide, and arsenic, respectively. The data presented for each parameter are discussed below.

- Phenol -- Both phenol and 2,4-dimethylphenol were detected in a number of Phase I groundwater samples. Of these two compounds, phenol was the most frequently detected and showed the highest reported concentrations. Phenol is, therefore, evaluated in this discussion as a single compound that is representative of the phenolic compounds as a group. The data on Figure 2.4-6 indicate that the highest phenol concentrations were reported in samples of deep groundwater from the following areas of the site: west-central (MW-6D), central (MW-1D), and east-central (MW-4D). The results for Well MW-4D may indicate the effects of the well's proximity to the former MGP/coking process area, while the results for Wells MW-1D and MW-6D may show the effects of groundwater flow toward Waukegan Harbor from source areas in the vicinity of the former MGP/coking process area and the former creosoting facility (Figure 2.4-6). The source of phenol in the sample from Well MW-3D is unknown at this time.

- Total BETX -- The data on Figure 2.4-7 indicate that the highest total BETX concentration was reported for the deep groundwater sample from the west-central portion of the site (Well MW-6D). This may indicate the effects of areally dispersed sources of BETX compounds along flow paths from east to west across the site. The possible presence of BETX source areas at several locations along such flow paths could result in increasing concentrations as groundwater flows toward the western site boundary.
- Cyanide -- The data on Figure 2.4-8 do not indicate an identifiable trend in the horizontal distribution of cyanide concentrations in groundwater. The data show similar concentrations in deep groundwater samples collected from different areas of the site, possibly resulting from the relatively mobile nature of cyanide in groundwater.
- Arsenic -- The data on Figure 2.4-9 indicate that the highest arsenic concentration was reported for a deep groundwater sample from the east-central portion of the site (Well MW-4D). This sampling location is closest to the former thionizer building, where arsenate compounds were used in gas purification processes. (The thionizer was used to recover sulfur from the gas purification stream during the manufactured gas period of WCP operations. The use of the thionizer eliminated the need for the oxide box purification process typical of many MGP plants). The relatively high arsenic concentrations in deep groundwater on the western portion of the site (Wells MW-6D and MW-5D) cannot be attributed to proximity to the former purification building.

2.4.5.2 Other Compounds

The results of Phase I groundwater analyses indicate occurrences of parameters that were not identified in the RI/FS work plan as typically associated with MGP/coking or creosoting operations. These parameters include three volatile organic compounds: acetone, 1,1-dichloroethane, and methyl ethyl ketone (Tables 2.2-23 and 2.2-27). Occurrences of acetone and methyl ethyl

ketone were generally reported for samples showing higher concentrations of BETX compounds and phenol (Table 2.4-13). These compounds are common laboratory contaminants (U.S. EPA, 1988), but the reported concentrations may have originated from current industrial activities at or near the site. The groundwater sample from Well MW-5S was reported to contain 700 µg/L 1,1-dichloroethane; this compound was not detected in any other groundwater or soil samples and is a degreasing agent not associated with MGP/coking or creosoting operations.

Two of the inorganic parameters detected in Phase I groundwater samples, arsenic and cyanide, were identified in the RI/FS work plan as potentially associated with MGP/coking operations and were discussed above (Section 2.4.5.1). Of the remaining detected inorganic parameters (Tables 2.2-22 and 2.2-26), the reported concentrations may be attributable to nearby industrial activities or laboratory contamination of samples. Reported concentrations of inorganic compounds were compared to available drinking water and surface water criteria to evaluate the potential significance of the occurrences. All reported concentrations of these inorganic parameters were below corresponding U.S. EPA drinking water standards, Illinois water quality standards (IWQS), and Lake Michigan water quality standards, with the following exceptions:

- Cadmium was reported at concentrations from 6.2 to 50.7 µg/L in samples from the five deep monitoring wells; these concentrations exceed the Maximum Contaminant Level (MCL) of 5 µg/L established for cadmium.
- Lead was reported at a concentration of 15.7 µg/L for the sample from Well MW-1D; this concentration slightly exceeds the current MCL of 15 µg/L established for lead.
- Iron was reported at concentrations exceeding the corresponding Secondary MCL (300 µg/L) in samples from two of the water table monitoring wells (up to 1,040 µg/L) and in samples from all of the deep monitoring wells (up to 1,200 µg/L).

- Manganese was reported at concentrations exceeding the corresponding Secondary MCL (50 µg/L) in samples from all the monitoring wells (reported concentrations from 52 to 885 µg/L).
- Selenium was reported at concentrations of 46 and 12 µg/L in samples from Wells MW-1D and MW-6D, respectively; these concentrations exceed the IWQS of 10 µg/L established for selenium in public and food processing water supplies.

2.4.5.3 Identification of Phase II Analytical Parameters for Groundwater

The first round of groundwater samples collected from monitoring wells installed in Phase II will be analyzed for the full-scan parameter list to establish an initial groundwater quality characterization. The second round of Phase II groundwater samples, to be collected from all the site monitoring wells, will be analyzed for the chemical parameters listed below:

- Phenolic compounds (see soil parameter list in Table 2.4-8);
- PAH compounds (see soil parameter list in Table 2.4-8);
- Volatile organic compounds (VOCs) (see list in Table 2.4-14);
- Arsenic (total, +III, +V);
- Cyanide, total and weak acid dissociable (corrected for sulfide interferences);
- Thiocyanate;
- Cadmium;
- Lead;
- Mercury;
- Selenium; and
- Total ammonia.

Cadmium was selected for Phase II groundwater analyses due to its apparent association with elevated concentrations of other MGP/coking and creosote compounds, and because cadmium concentrations exceeded the corresponding MCL at several sampling locations. Selenium was included to provide groundwater quality data for correlation with soil quality data collected for this parameter, and because two groundwater samples showed selenium concentrations

exceeding the corresponding IWQS. Mercury was included to provide groundwater quality data for correlation with soil quality data collected for this parameter.

Total ammonia will be included in Phase II groundwater analyses due to its typical association with MGP/coking wastes/by-products and its identification as a "pollutant of concern" in the Remedial Action Plan for the Waukegan Area of Concern (Hey and Associates, Inc., 1992).

Iron and manganese were not included in the analytical parameter list for the second round of Phase II because the Secondary MCLs for these parameters are not enforceable standards.

Section 3.4.1 discusses the entire Phase II groundwater sampling program and all Phase II analytical parameters.

2.4.6 Ecological Survey

There are no known listed endangered or threatened species or sensitive natural features present at the within the property boundary (CH₂M Hill, 1983; IDOC, 1992; Grosso, 1992). Further, the site likely does not provide exceptional habitat for any particular flora or fauna (CH₂M Hill, 1983; Grosso, 1992). Because Waukegan Harbor is an anthropogenic structure for industrial and commercial marine uses, the harbor's value for fish and wildlife habitat is limited (Hey, 1992).

There are, however, several significant ecological features in the Waukegan area (CH₂M Hill, 1983; IDOC, 1992; Grosso, 1992). These features include several state listed species, Lake Michigan, Lake Michigan beach habitat (including Waukegan Beach) and the Illinois Beach State Park dunesland habitat. The Lake Michigan beach and dunesland habitats provide migratory and nesting habitat for a variety of fauna (CH₂M Hill, 1983).

Land use in the vicinity of the site is primarily industrial and commercial/industrial. Land use on the site has historically included

commercial/industrial development, various industrial-related uses and temporary uses of otherwise vacant land.

North of the site is OMC Plant No. 2. North of OMC's Plant No. 2, a project is currently in progress to build hazardous waste containment cells for soils and sediments containing PCBs. The soils were found north of OMC Plant No. 2, and the sediments (which contain greater than 50 parts per million PCBs) were removed from a nearby drainage ditch. Further north of OMC's Plant No. 2 is the North Shore Sanitary District's Waukegan Sewage Treatment Plant. Illinois Beach State Park is situated approximately 1.5 miles north of the site.

West of the site is Waukegan Harbor. Waukegan Harbor is an industrial and commercial harbor. Lake-going freighters deliver gypsum to National Gypsum and cement to LaFarge Corporation, two industrial facilities situated on the west side of Waukegan Harbor. Also, private boats have access to repair and docking facilities in the northern part of the harbor.

Waukegan Harbor was recently dredged to remove sediments containing PCBs. The dredging process was designed to leave in place any sediment with PCB concentrations less than 50 parts per million. Former Slip No. 3, situated northwest of the Harbor, has been converted to a hazardous waste impoundment for soils containing PCBs. This PCB hazardous waste impoundment is not lined. A slurry wall surrounds the former slip, and a cap is planned to cover the PCB hazardous waste impoundment.

South of the site is OMC's Plant No. 1. Operations at OMC's Plant No. 1 include the manufacturing and testing of marine motors. An outdoor testing area on the west side of the plant utilizes Waukegan Harbor for the constant running and testing of dock-mounted outboard motors. South of OMC's Plant No. 1 is the City of Waukegan Water Plant, the Waukegan Harbor inlet, a rock breakwater which extends into Lake Michigan, and a 1,000-boat marina. The Waukegan River flows into Lake Michigan approximately 0.5 mile south of the harbor.

East of the site is Seahorse Drive. Asphalt parking lots and Waukegan Public Beach are situated east of Seahorse Drive. A Lake Michigan public swimming area is situated along the beach southeast of the site.

Historically, the northwest quadrant of the Site has been utilized by Larsen Marine for seasonal boat storage. Also, OMC has historically utilized portions of the site for industrial and commercial purposes. For example, OMC has stored various petroleum and PCB oils on-site. OMC has also conducted fire prevention and response training activities on-site.

Currently, the northwestern portion of the site is utilized by Larsen Marine, a commercial business engaged in boat sales, servicing, repair, refueling, storing and launching. In 1991, a new slip was excavated within the northwest quadrant for Larsen Marine. Additional buildings and facilities are planned for the land areas surrounding the new slip. In the future, Larsen Marine may expand to occupy a larger portion of the Site.

The western portion of the site has been used for stockpiling dredged material from the lake or harbor and stockpiling soil from the excavation of the new slip. A portion of the stockpiled soil from the excavation of the new slip was determined to contain PAHs and is contained in a membrane-lined cell within a fenced area immediately east of the stockpiled dredged spoils.

The southeast portion of the site is currently occupied by OMC's data building, administration building, parking lots, and lawn space.

Until about 1990, the central and eastern portions of the site were routinely utilized by the City of Waukegan for public vehicle parking areas during beach-front festivals.

2.4.6.1 On-Site Ecological Features

The site currently consists of vegetated and nonvegetated areas. The vegetated areas comprise approximately three-fifths of the areal extent of the site and are either lawn or ruderal old field plant communities. The nonvegetated areas comprise approximately two-fifths of the areal extent of the site and consist of buildings, asphalt, packed gravel, stockpiled contaminated soils, stockpiled dredge spoils, and surface water. The approximate areas of ecological features are listed in Table 2.4-15. Figure 2.4-10 shows the ecological features of the site.

A historical aerial photograph review indicated the presence of an open water/emergent wetland complex in the northeast corner of the site in air photos dated 1939 through 1967 (reference Air Photos). This wetland complex was not evident in photos dated 1974 through 1991. There are currently no wetland areas on the site (Barr Staff, 1992; Hey, 1992). The remainder of the site was apparently comprised of industrial structures, coal stockpiles, and vegetated areas in photos dated 1939 through 1967. The industrial structures are not evident in photos dated 1974 through 1991 except for the OMC office building and parking lot situated along the southern and southeastern side of the site.

The substrate at the site and in the general vicinity of the site is predominantly fill. Fill was first placed at the site for industrial use development in the early 1900s. Industrial activity dominated the site until at least 1972. Industrial building structures were demolished in approximately 1972 and much of the site has become overgrown with successional weedy plant communities. Other areas of the site have been utilized for building and parking lot placement (CH₂M Hill, 1983).

The ruderal old field plant community is comprised predominantly of common annual and perennial roadside grasses and forbs. A woody component exists in the southern portion of this old field habitat and dominates only in small patches. The woody component of the old field habitat is dominated by cottonwood trees and saplings. Box elder saplings are present but sparse. One red-osier dogwood shrub was observed in the southern portion of the old field habitat.

The majority of the old field habitat area exhibits a fairly even grade. Other physical features of this area include nonvegetated strips of land used for vehicular travel and piles of timber, rubble, soil, and brush.

The on-site lawn area is comprised of a level surface covered by typical lawn grass, overlain in places by ornamental coniferous and deciduous trees.

On-site areas comprised of buildings, asphalt, packed gravel, and stockpiled contaminated soils offer very limited use as ecological components of the site. The stockpiled harbor dredge spoils area supports some patches of

vegetation, primarily annual forbs and cottonwood trees and saplings. The majority of the stockpile, however, is void of vegetation.

The surface water in harbor Slip No. 4 (New Slip) potentially provides an aquatic habitat component to the site. No emergent or submergent vegetation or aquatic wildlife was observed in the New Slip during the site reconnaissance.

2.4.6.2 Off-Site Ecological Features

Several plant and animal species have been observed in the vicinity of the site which are considered to be significant ecological features. None of these plant or animal species, however, are known to occur on the project site.

Sixteen plant and animal species in the Waukegan Expanded Study Area (ESA) are presently listed as state endangered or threatened species (Hey, 1992). The Waukegan ESA comprises a land area centered around Waukegan Harbor approximately 6 miles in length along the shore of Lake Michigan with a width of less than one mile. With one exception, all 16 listed species are found only within Illinois Beach State Park (Hey, 1992). The only state listed endangered or threatened species sighted outside the state park boundaries, but still within the Waukegan ESA, is the common tern.

The common tern is listed as an endangered species by the State of Illinois. The only known occurrence of this species within the State of Illinois is the colonial nesting site situated at the Commonwealth Edison Waukegan Power Plant (Hey, 1992) located approximately 1.5 miles north of the site. Grosso (1992) has stated some concern that contaminants from the Waukegan Harbor area may be negatively impacting the reproductive success of this common tern nesting colony. Grosso (1992) concurred with Hey (1992), however, that no specific studies have addressed any such impacts.

Hidorn (1992) has been aware of the tern nesting colony since 1987 and has made informal observations over the past five years while conducting area fisheries management operations. Hidorn stated that currently there are 20 common tern nests in the colony. Hidorn further stated that over the past five years, he has observed no evidence or indications of toxic effects

(deformities, high mortality rates) on this tern colony. Hidorn, however, has not conducted any formal studies regarding this tern colony.

Waukegan Beach is the natural area east of the site. The beach extends north to Illinois Beach State Park. The Illinois Department of Conservation (IDOC) stated that several endangered, threatened, or rare bird species have nested or attempted to nest at Waukegan Beach. The IDOC letter referenced the common tern, piping plover, ring-billed gull, Brewer's blackbird and yellow-crowned night heron. None of these bird species, however, are known to nest adjacent to the site (IDOC, 1992).

Three threatened or endangered plant species are known to occur at Waukegan Beach between the breakwater and the sewage treatment plant (IDOC, 1992). These species are American sea rocket (state threatened), seaside spurge (state endangered) and American beachgrass (state endangered).

Sea rocket and seaside spurge are adapted to sand pocket habitats and are likely only to be found as primary successional species of the upper reaches of a bare sand beach habitat (Glosser, 1992). Their range is limited by constant repetitive pounding of the surf from the lake and by competition from other terrestrial species further inland from beach habitat (Schwegman, 1992).

Beachgrass may occur as high as the foredune just beyond the upper reaches of the beach sand habitat, but is not likely occur further inland (Glosser, 1992). Beachgrass, sea rocket and seaside spurge are not likely to occur at a fill site without the presence of beach or dune habitat (Schwegman, 1992).

Two state threatened fish species were reported in Lake Michigan between Zion and Waukegan Harbor during 1972-1974 annual Commonwealth Edison environmental monitoring studies (Hey, 1992).

There is no available information on impacts of fish and wildlife populations in the Waukegan ESA (Hey, 1992). Specifically, there is no available information on bird or animal deformities, bird, or animal reproduction problems or reports of fish tumors or other abnormalities in the Waukegan study area (Hey, 1992).

Phytoplankton and zooplankton population studies were conducted in the Waukegan Harbor area 1972-1974 by Commonwealth Edison (Hey, 1992). Protozoan community response to Waukegan Harbor sediments was examined by Ross in 1988 (Hey, 1992). A 1981 benthic toxicity study indicated that harbor sediment has toxic effects on water fleas, scuds, mayfly nymphs, midge larvae, and snails (Hey, 1992); mortality rates on fingernail clams did not increase, however. Hey (1992) concluded that additional study is required to determine whether phytoplankton and zooplankton populations have been degraded in the Waukegan ESA.

2.4.6.3 Waukegan Harbor Sediment Quality

Available information on biological effects of Waukegan Harbor sediments is limited because the information is based largely on deviations from normal concentrations rather than toxic response. However, it appears lead, zinc, and cadmium in harbor sediments pose the greatest potential risks to aquatic life in the harbor (Hey, 1992).

Laboratory analyses were conducted on harbor sediment samples during a 1986 study funded by the State of Illinois (Risatti and Ross, 1990). Harbor sediment samples were collected from surficial sediment using ponar and petit ponar hand operated dredges. The analyses included PCBs, oil and grease, priority pollutants and 22 other compounds and trace elements. Three toxicity tests (bacterial, algal, and nematode worm) were performed on sediment sample elutriates with varying results.

The study reported that total PCB concentrations in the analyzed harbor sediments varied from 5 to 17,251 ppm. Oil and grease concentrations ranged from 0.3 to 5.2 percent. In addition, elevated concentrations were reported for the following metals: cadmium, copper, manganese, lead, zinc, and iron. Sediments with the highest concentrations were situated in the upper harbor area and southwestern slip. Sediments from the mouth of the harbor contained statistically significant lower metals concentrations. The report concluded that Waukegan Harbor sediments contain high concentrations of potentially hazardous priority pollutant metals and PCBs.

The results of toxicity tests from 23 sample stations in Waukegan Harbor identified three stations of high toxicity and four stations of low toxicity. The locations of these seven stations are intermixed within Slip 3 and the upper harbor.

2.4.6.4 Lake Michigan and Waukegan Harbor Surface Water Quality

Lake Michigan water quality samples near Waukegan Harbor have been collected by the City of Chicago Water Quality Surveillance Section (Chicago) on a biennial basis since 1970 (IEPA, 1990). The sampling stations in this area are part of Chicago's North Shore Lake Survey. This survey is comprised of ten sample locations. The three northern-most sample locations are approximately 1 mile off-shore and evenly spaced between Waukegan Harbor and the Great Lakes Naval Center (3 miles south). The parameters for analyses of these water samples consisted of conventional pollutants and phenol-like substances.

In May and September 1990, rounds of Lake Michigan water quality samples were collected from five sample stations between Waukegan Harbor and Chicago. The mean metals concentrations data from these samplings are presented in Hey (1992). Other water quality data from these samples will be presented by the IEPA in their "Lake Michigan Water Quality Report 1990," expected to be printed late 1992 or in 1993 (Schacht, 1992).

Recent years data of annual water quality testing of the main city of Waukegan intake source (6,244 feet off-shore in Lake Michigan) indicated that the water quality meets the standards set forth by the Safe Drinking Water Act (Hey, 1992).

In 1990, water samples were collected from Waukegan Harbor (Hey, 1992). Analytical parameters were selected based on those for which standards have been set via the Public Water Supply Standard (35 IL Adm. Code 302), General Use Standard (35 IL Adm. Code 302), and the Lake Michigan Standard (35 IL Adm. Code 302). These standards include priority pollutant metals. Analyses indicated that the most serious water quality problems in the harbor were with ammonia, cyanide, phenols, and dissolved oxygen.

SECTION 3
PHASE II REMEDIAL INVESTIGATION WORK PLAN

3.1 INTRODUCTION/OBJECTIVES

Results of the Phase I investigation were used to refine the design of the Phase II investigation. The Phase II investigation will involve the placement of soil borings, sampling and analysis of soils for contaminants, sampling and analysis of soils for geotechnical parameters, installation of additional monitoring wells, permeability testing, groundwater sampling and analysis, and sampling and analysis of soil and groundwater for evaluation of remedial technologies.

Objectives of the Phase II investigation include:

- Provide additional information on the lateral extent of soil contamination identified in Phase I.
- Characterize the vertical extent of soil contamination in areas identified as contaminated in Phase I.
- Characterize the soil quality and lithology of the soil stockpiles.
- Characterize the site geology and stratigraphy.
- Evaluate hydraulic characteristics of the sand unit.
- Assess site groundwater quality downgradient of identified source areas.
- Characterize the site's groundwater flow regime.
- Characterize the geotechnical properties of the till and sand units for use in the development of remedial alternatives.

- Provide data needed to evaluate potential treatment technologies for remedial alternatives.

3.2 SOIL QUALITY/CONTAMINANT DISTRIBUTION INVESTIGATION

3.2.1 Soil Borings

3.2.1.1 Soil Boring Placement

Phase I analytical and field screening results indicated that contaminants are concentrated in three areas at the WCP site: the former wood treating plant area, the former MGP/coking facility area, and the northeast portion of the site. Soil borings will be placed in these areas to evaluate the vertical extent and confirm the lateral extent of contamination. Boring locations were determined according to the following rationale:

- Borings in areas identified as highly contaminated based on Phase I results will be used to evaluate the vertical contamination profile characteristics of such areas;
- Borings placed in an area identified as intermediate in contamination (or at the fringe of contamination) based on Phase I results are expected to show the attenuation of contamination with depth; and
- Borings placed outside the limit of contamination identified from Phase I results will be used to assess the apparent migration of dissolved phase contaminants (based on Phase I observations of elevated organic vapor concentrations in soil samples from above the base of the shallow groundwater unit) or separate phase contaminants.

The proposed locations of Phase II soil borings are shown on Figure 3.2-1. Thirty-four soil borings are proposed for the former wood treating plant area, the former MGP/coking facility area, and the northeast portion of the site.

Based on the results of the Phase I investigation, several transects of borings are proposed for the former MGP/coking plant area and the northeast portion of the site. Each transect has borings in highly contaminated areas, at the fringe of contamination, and outside the limits of observed contamination. Twenty-four soil borings are proposed for the former MGP/coking plant area and seven borings are proposed for the area of the former ponds.

Three borings will be placed to assist in characterizing the contamination in the area of the former wood treating facility. This area of the site was the object of significant investigative activity prior to the construction of Slip No. 4. Four trenches and more than 80 soil borings were placed in the northwest portion of the site during investigations associated with construction of Slip No. 4 (Canonie, 1990 and 1991). Soil quality data (primarily for PAHs and phenolic compounds) were reported for selected soil samples from the trenches and borings. The boring logs and soil quality data from this work, along with the Phase I and Phase II investigation findings, will be used in the RI for assessing sand unit geologic conditions and contaminant characterization in the area of the new slip and former creosoting facility. In addition to the Slip No. 4 investigation, the current location of Larsen Marine on the site property has been investigated with trenches. OMC reportedly placed three east-west trenches as a geotechnical investigation during August 1989 in the area north of Slip No. 4 within the Larsen Marine fenced area. Although no documentation of the exact locations of or observations from these trenches has been published, it is reported that the only evidence of contamination observed in the soil or groundwater during trench placement was the presence of coal in a zone about 1 foot thick, starting 6 to 8 inches below the ground surface, in a trench about 135 feet south of Sea Horse Drive. The material below the coal was characterized as clean sand (OMC, 1990b).

The soil borings will be advanced using hollow-stem auger drilling techniques. All borings will be sampled at 2.5-foot intervals (in accordance with the approved Final Work Plan) using a standard split-spoon sampler and in accordance with the ASTM D-1586 for the Standard Penetration Resistance Test. All soil borings will be advanced to the top of the till unit. Three borings will be advanced at least 10 feet into the till unit so that geotechnical samples of the till can be collected. The proposed locations of these borings

are shown on Figure 3.2-1. Except when a well is installed into the borehole, boreholes will be abandoned with neat cement grout upon completion as described in Section 4.1.3 of the October 1991 FSP.

Each boring will be logged by an experienced geologist. Soil samples will be classified according to ASTM D-2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) as described in Appendix B of the October 1991 FSP. In addition, field screening as described in Attachment 4 of the October 1991 FSP will be performed on each sample.

Soil cuttings that are not saturated with oil or tar will be spread on the ground in the vicinity of the boring or well. Soil cuttings and soil samples that are saturated with oil or tar, as well as visibly contaminated protective clothing and equipment or any other items or materials which are exposed to or may contain pollutants, will be placed in Department of Transportation-approved 17-H drums, sealed, and labeled. Based on Phase I data, it is anticipated that a significant portion of any organic vapors that may be present in cuttings from off-site borings would be due to the presence of methane. If soil cuttings that have been spread in the vicinity of an off-site boring or well show organic vapor concentrations exceeding 100 ppm the day after spreading, these soils will also be containerized. Drums will be stored in a central location within the fenced portion of the site.

All soil boring locations will be tied into the site orthogonal coordinate system and surveyed relative to the mean sea level datum.

3.2.1.2 Soil Sampling

The soil sample collection objectives are to:

- Characterize the nature and extent of chemical constituents (PAHs, phenolic compounds, BETX, arsenic, cadmium, lead, mercury, selenium, and cyanide) in the soils from the ground surface to the base of the surficial sand unit; and
- Determine the stratigraphy of the site.

Soil samples will be collected for tests according to the schedule described below and summarized in Table 3.2-1.

The following three field observations will be conducted for all samples from all borings.

- Field Soil Classification (see Appendix B of the October 1991 FSP).
- Field Screening (see Attachment 4 in the October 1991 FSP).
- Field pH (see Attachment 4a in the October 1991 FSP).

The following laboratory analyses will be performed for a defined set of samples and for additional samples as indicated by field observations. The defined set of samples will be soil samples collected from each boring at: (1) a depth interval of 2 to 4 feet to assess potential impacts of unsaturated zone soils on groundwater quality; (2) a depth interval of 7 to 9 feet and a depth interval of 17 to 19 feet to assess the vertical extent of contamination below the water table; and (3) from just above the contact between the sand unit and the till unit (at depths of approximately 26 to 28 feet) because coal tar and creosote may migrate as dense nonaqueous phase liquids.

- PAHs: The samples will be analyzed for the list of PAH compounds in Table 2.4-8.
- Phenolic Compounds: The soil samples analyzed for PAHs will also be analyzed for phenolic compounds listed in Table 2.4-8. The data will be used to characterize the subsurface distribution of phenolic compounds.
- Inorganic Compounds: All samples that are analyzed for PAHs will be analyzed for arsenic, cadmium, lead, mercury, selenium, and cyanide.
- VOCs (BETX): Samples selected for laboratory analysis of PAHs will also be submitted for analysis of BETX. As specified in the approved Final Work Plan, when the total organic vapor headspace

concentration of a sample apparently not containing PAHs exceeds 100 ppm, the next interval down may be sampled for analysis of BETX. This method of alternating samples is used to minimize the opportunity for volatilization from the sample during the sample collection process.

3.2.1.3 Soil Sampling Equipment and Procedures

Samples to be submitted for laboratory analysis of VOCs will be collected using brass tube liners (see Attachment 1 of the October 1991 FSP for procedures). All other samples will be obtained with a split barrel sampler in accordance with the procedures outlined in the October 1991 FSP. Upon retrieval of the split barrel, the soils will be classified, visually inspected for contamination, and screened for headspace organic vapor concentrations and pH. Samples to be submitted for analysis of inorganic compounds, semivolatile compounds, pesticides, and PCBs will be packaged in clean sample containers. Any remaining sample will be placed in a clean, airtight glass jar.

Laboratory analytical methods are described in Section 9 of the October 1991 QAPP. The laboratory will be requested to report estimated concentrations and to indicate when the criteria for reporting estimated concentrations has not been met. The Phase II sample and analysis program update is in Table 3.2-2. Sample containers, preservation, and technical holding times are summarized in Table 3.2-3. Soil sampling and handling procedures are described in detail in the FSP and QAPP.

3.2.2 Ground Surface Soil Samples

The purpose of the ground surface soil samples is to characterize the soil quality for the 0 to 6-inch depth interval at locations across the site and at selected off-site locations (for use in direct-contact/ingestion scenarios in baseline risk assessment evaluations. Ground surface soil samples from the 0 to 6-inch depth interval will be collected with a stainless steel trowel at the locations shown on Figure 3.2-2 and at the locations of prior Background Soil Samples BS-01, BS-02, and BS-04 (Figure 2.2-2). The ground surface soil samples will be designated with a "GS" prefix and a two-digit numeric identifier (e.g.,

GS-01). The samples will be collected in accordance with procedures defined in Attachment 1 of the October 1991 FSP. These soil samples will be analyzed for PAHs, BETX, phenolic compounds, arsenic, cadmium, lead, mercury, selenium, and cyanide. The ground surface soil sample in the vicinity of former the thionizer building and sulfur pile will be analyzed for corrosivity and reactivity.

3.2.3 Soil Stockpile Soil Characterization

The soil quality and lithology of the on-site soil stockpile and designated soil stockpile will be characterized during the Phase II investigation.

3.2.3.1 Soil Stockpile Soil Samples

Three soil borings are proposed for the soil stockpile area. The proposed locations of these borings are shown on Figure 3.2-1. The purpose of these borings is to characterize the soil quality and lithology of the soil stockpile. Soil samples will be collected from each soil stockpile boring at depth intervals of 4.5 to 6.5 feet below the top of the stockpile, 14.5 to 16.5 feet below the top of the stockpile, and 2 to 4 feet below the base of the stockpile. These soil samples will be analyzed for the full scan of Phase I analytical parameters (inorganic parameters listed in Table 2.2-9, volatile organic compounds listed in Table 2.2-10, semivolatile organic compounds listed in Table 2.2-11, and the pesticides and PCBs listed in Table 2.2-12).

As these soil stockpile borings will extend through the soil stockpile and underlying sand unit to the top of the till, analytical samples from beneath the soil stockpile will be collected for the analyses described in Section 3.2.1.2, Soil Sampling. Soil boring advancement will be as described in Section 3.2.1.1, Soil Boring Placement. Soil sampling equipment and procedures will be as described in Section 3.2.1.3, Soil Sampling Equipment and Procedures.

3.2.3.2 Designated Soil Stockpile Soil Characterization

Soil quality data for excavated materials placed in the designated soil stockpile storage area (Figure 1.3-1) are available in reports of investigations performed prior to and during construction of the new slip (Canonie, 1990 and

1991). Analytical data for the specific, predefined areas of soils that were ultimately placed in the designated soil stockpile are available only for semivolatile organic compounds; i.e., PAHs and phenolic compounds. In Phase II of the RI, three soil samples will be collected from the designated soil stockpile to: (1) provide soil quality data for parameters not assessed in prior investigations; and (2) provide current concentration data for PAHs and phenolic compounds to assess the nature of the "designated" soils as placed.

Soil samples will be collected from the designated soil stockpile at three locations to be selected in the field, based on safety and access issues related to the stockpile's configuration. At each location, a soil sample will be collected with a hand auger from a depth of approximately 18 inches below the top of the stockpile. Sampling procedures will be in accordance with the October 1991 FSP. Sample access points created in the stockpile cover will be repaired following sampling. Each of the three soil samples collected from the designated soil stockpile will be analyzed for parameters in the Phase I full-scan parameter list.

3.3 HYDROGEOLOGIC INVESTIGATION

The Phase II hydrogeologic investigation will consist of pilot boring placement and monitoring well installation, a monitoring well survey, water level measurements, and permeability testing. The hydrogeologic model will be refined following the collection of additional groundwater elevations, slug test data, and pumping test data during the second phase of the investigation.

3.3.1 Monitoring and Pumping Well Installation

Eighteen monitoring wells, two piezometers, and one pumping well will be installed at or in the vicinity of the site as part of the Phase II investigation. One piezometer (P-101) will be abandoned. Proposed locations of the monitoring wells and on-site piezometer are shown on Figure 3.3-1. The proposed location of the off-site piezometer is shown on Figure 3.3-2. These locations will: (1) provide groundwater quality information to address identified data gaps in the Phase I investigation; (2) complete the characterization of site groundwater flow patterns; and (3) provide for pumping

and slug test permeability characterization. The rationale for the proposed location of each well is summarized below.

Water table Well MW-7S will be placed along the eastern boundary of the site, Well MW-8S will be placed in the southeast corner of the site, Well MW-10S will be placed along the southern boundary of the site, and Well MW-11S will be placed in the northwest corner of the site. These wells are positioned to act as monitoring points at the site boundaries where data gaps are present. Monitoring data from these and existing wells will be used to assess the potential for radial groundwater flow and contaminant migration from the site.

Wells MW-9S and MW-9D will be placed immediately adjacent to an area thought to be contaminated based on the results of the Phase I investigation. The proposed location is near the ponding areas of the former coke plant facility and is shown on Figure 3.3-1. This well will act as a groundwater quality monitoring point in a former source area on site. In addition, the well will help to further delineate groundwater flow patterns. If soils in the immediate vicinity of the MW-9 well nest are contaminated with oil or tar that appears likely to flow into the well, the MW-9 well nest will be deleted from the investigation program. If free-phase oil or tar is found near the base of the groundwater unit, Well MW-9D will be screened above the level of the tar or oil.

For key areas immediately east and north of the site, long-term monitoring installations would provide more representative groundwater quality and elevation data than temporary monitoring installations. Accordingly, water table Wells MW-12S through MW-15S and Piezometer P-105 will be placed north and east of the site if OMC does not have viable and accessible monitoring wells or piezometers of known construction near these proposed locations. The wells will provide off-site groundwater quality data. The wells and piezometer will also help to further delineate groundwater flow patterns and assess the potential for groundwater flow toward areas north and east of the site. The MW-12 and MW-13 well nests may be moved as much as 200 feet further east than shown on Figure 3.3-1 if there are secure, accessible locations available. In this instance, a piezometer will be placed at the MW-12 nest location shown on Figure 3.3-1.

Wells MW-7S through MW-15S will be nested with deeper Monitoring Wells MW-7D through MW-15D. The deeper wells will be screened in the interval just above the till at elevations similar to the existing deep monitoring wells. These wells will provide vertical hydraulic gradient information and will give an indication of groundwater quality and flow directions at the base of the sand aquifer.

Piezometer P-106 will be placed at the proposed location shown on Figure 3.3-1. This piezometer will be used as an observation point during the pumping test (Section 3.3.4, Permeability Testing).

With the addition of the Phase II monitoring well nests, the monitoring well network at the site will allow mass flux calculations to be made for all potential groundwater receptors (Lake Michigan, Waukegan Harbor, slip). Well Nests MW-3S/MW-3D and MW-15S/15D will provide data for mass flux calculations at the northern edge of the site. Well Nest MW-1S/MW-1D will provide data to be used in mass flux calculations for the slip. The data from Well Nests MW-5S/MW-5D, MW-6S/MW-6D, and MW-11S/MW-11D will be used in mass flux calculations for the harbor. Well Nests MW-7S/MW-7D, MW-4S/MW-4D, MW-12S/MW-12D, MW-13S/MW-13D, and MW-14S/MW-14D will provide information on potential mass flux across the eastern edge of the site. Well Nests MW-8S/MW-8D and MW-10S/MW-10D will provide information on mass flux at the southern edge of the site.

Monitoring Wells will be constructed in accordance with the Illinois Water Well Construction Code (Chapter I, Subpart 920). OMC and the City of Waukegan have specified that wells on their property outside the fenced site are to be finished flush with the ground surface. Risers will be constructed of 2-inch nominal diameter stainless steel casing. The water table wells will have 10-foot long stainless steel screens and the deeper wells will have 5-foot long stainless steel screens. The water table wells are designed with longer screens so that groundwater levels in the wells will remain within the screened intervals during seasonal fluctuations of the water table. The deeper wells will utilize 5-foot long screens because they are not designed to intersect the water table and can, therefore, monitor a more distinct groundwater interval.

Well installation will be performed using hollow-stem auger drilling equipment. Where possible, monitoring wells will be installed into pilot boring boreholes. Well construction procedures will be the same as those discussed in Section 3.7, Monitoring Well/Piezometer Installation, in the October 1991 FSP. Well construction methods for the water table wells will be designed to account for the limited distance between the ground surface and the top of the screen.

The piezometer construction will be the same as the construction of the water table monitoring wells, except that the riser and screen will be 1-inch diameter PVC. The screen at Piezometer P-105 will be 10 feet long. The screen at Piezometer P-106 will be 20 feet long.

A 4-inch diameter well (PW-1) will be installed at the site for use as a pumping well during the pumping test (see Section 3.3.4, Permeability Testing). The proposed location of this well is shown on Figure 3.3-1. Well installation will be performed using 9/16-inch water rotary drilling techniques. Installation materials will be the same as for the other Phase I and II monitoring wells, with the exceptions that the well will be 4 inches in diameter and that the screen will be 20 feet long. The 4-inch diameter well will be developed to account for fluids that may be lost during drilling, allowing the well to also be used for collecting groundwater samples in Phase II.

Each boring for the placement of a well will be sampled at 2.5-foot intervals, using a standard split-spoon sampler in accordance with the ASTM D-1586, Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Each boring will be logged by an experienced geologist. Soil samples will be classified according to ASTM D-2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) as described in Appendix B of the October 1991 FSP. In addition, field screening as described in Attachment 4 of the October 1991 FSP will be performed on each sample. Soil samples from intervals for which field screening results indicate the presence of an oil sheen or organic vapor headspace concentrations of 100 ppm or greater will be considered for analysis of parameters in Table 2.4-8. Up to three samples from the borings at each well nest location may be submitted for analysis. No soil samples from the monitoring well borings will be submitted

for analysis if field screening results do not indicate the presence of contamination according to the criteria described above.

Because a monitoring well nest is proposed for the northwest corner of the site at the location of Piezometer P-101, Piezometer P-101 will be properly abandoned during the second phase of the investigation. Abandonment will consist of overdrilling the piezometer and backfilling the borehole with neat cement grout.

Soil cuttings, drilling fluids, and other investigation-derived wastes will be managed as described in Section 3.2.1, Soil Borings.

3.3.2 Survey of Wells

The elevations of the top of casing (TOC) and of the ground level at each newly installed well will be surveyed relative to the mean-sea-level datum used to survey the Phase I monitoring wells and piezometers and the existing wells. The well locations will also be tied into a site orthogonal coordinate system.

3.3.3 Water Level Measurements

Discrete Measurements: Groundwater elevations in the new and existing monitoring wells and piezometers will be measured on an approximate monthly basis beginning after approval of this document and continuing until the draft Remedial Investigation Report is submitted. The surface water elevation in Waukegan Harbor will also be measured on each occasion that groundwater elevations are measured. Surface water elevations measured in the harbor will represent water elevations in Slip No. 4 and Lake Michigan. Similarly, groundwater levels in available OMC monitoring wells north of the site, and surface water elevations in the ditch north of OMC Plant No. 2 and in the ditch located off the northeast corner of the site, will be measured during each measurement event. Groundwater flow directions and gradients will be estimated from the water level information.

Continuous Measurements: Water levels will be measured continuously in two of the water table monitoring wells (MW-1S and P-104) and one of the deeper

wells (MS-1D) for approximately one week immediately prior to the pumping test. The data collected will be used to assess the relationships between groundwater elevations, surface water levels, and recharge events. An electronic data logger and a sensitive pressure transducer will be used to record the water level elevation every 10 minutes during the continuous water level measurement period. Precipitation data will be obtained from an on-site rain gage and compared with records from the local weather service.

3.3.4 Permeability Testing

Slug Tests: During the Phase II investigation, slug tests will be conducted in all of the newly installed monitoring wells in order to estimate the horizontal hydraulic conductivity of the sand unit. The slug tests will be conducted in the manner described in Section 2.2.2.4.

Modified Triaxial Permeability Tests: A modified triaxial permeability test will be conducted on at least three samples of the upper portion of the clay till unit to determine the vertical permeability of the till unit. The triaxial permeability test involves placing an undisturbed soil sample under a confining pressure to represent natural conditions. The test is then run using standard falling head permeability test procedures for fine-grained soils.

Pumping Test: A 24-hour pumping test will be conducted in the 4-inch well (PW-1). Results of the pumping test will be used to estimate the hydraulic conductivity of the sand unit. The pumping well will be installed approximately 15 to 25 feet south of monitoring wells MW-1S and MW-1D. Based on slug test results, it is expected that Well PW-1 will be pumped at an approximate rate of 15 gallons per minute for a maximum of 24 hours. Observations during the test may require a change of pumping rate. During the pumping test (which will consist of a 24-hour pumping phase and at least a 24-hour recovery phase), continuous water level measurements will be measured in Monitoring Wells MW-1S and MW-1D and in Piezometers P-104 and P-106. Discrete water level measurements will be measured at four-hour intervals in Monitoring Wells MW-6S, MW-6D, MW-9S, and MW-9D and Piezometer P-103. As described in Appendix I, a simulation of this pumping test design in the groundwater flow model predicted that meaningful water level data could be collected at Monitoring Wells MW-1S and MW-1D. The

simulation also predicted that the boundary effects of the slip wall may also be observed in the water level data obtained from Monitoring Wells MW-1S and MW-1D. Since the pumping well will essentially penetrate the aquifer fully, the drawdown data obtained from observation wells will not have to be corrected for partial penetration effects.

The water pumped from Well PW-1 during the pumping test will be pumped into a storage tank on site. The water will be treated on site using a combination of carbon filters for the removal of organic compounds and an iron-based electrochemical precipitation system for removal of arsenic and cyanide. Treated water will be discharged to the ground in the vicinity of surficial soil sample locations SS-12 and SS-13. Water will be discharged at a rate of approximately 10 gpm. Precipitate from the arsenic and cyanide removal system will be containerized and stored on-site pending landfill disposal.

3.3.5 Hydrogeologic Model Development

In order to perform subsequent simulations of potential remedial measures for groundwater during the FS and provide flow path information for contaminant fate and transport modeling, the hydrogeologic model will be refined following the collection of Phase II data. Relevant Phase II data will include additional groundwater elevations, slug test data, and pumping test results. The modeled hydraulic conductivity of the sand aquifer will be adjusted based on the results of the additional slug tests and the pumping test. If Phase II geologic data and model calibration efforts indicate that significant changes in hydraulic conductivity within the sand unit occur within discrete zones and information is available to estimate the extent of those zones, such zones will be simulated. If necessary for the simulations of potential remedial measures, additional modifications to the model may be made. Such modifications may include simulating the slip as a leaky wall instead of as a head-specified line sink, simulating the ditch north of OMC Plant No. 2 with head-specified areal resistance elements, simulating smaller areas of no infiltration or areas of lesser or greater infiltration based on surface soil types, simulating the sloping base of the aquifer (till unit), simulating leakage from or to the till unit, and simulating the containment cells and groundwater extraction wells north of OMC Plant No. 2.

During calibration procedures for the groundwater flow model, the primary goal will be to produce a representative simulation of groundwater flow patterns interpreted from measured groundwater elevations. Variations in observed flow patterns will be assessed relative to the steady-state simulations. In addition, predicted groundwater elevations will be compared to field-measured values of groundwater elevation. The calibration error will be assessed. Calibration error is expected to consist of transient effects not represented in the model, measurement error, and survey error. Hydraulic conductivity, head-specified values, and recharge will be adjusted by trial and error until the predicted groundwater elevations at as many observation points as possible fall within the calibration error.

A sensitivity analysis will be conducted on the calibrated model to quantify the uncertainty in the calibration caused by uncertainty in estimates of aquifer parameters, aquifer stresses, and boundary conditions. During the sensitivity analysis, calibrated values for hydraulic conductivity, recharge, and boundary conditions will be systematically changed within previously established plausible ranges. Effects of the parameter changes in the average measure of error in groundwater elevation will be reported. The spatial distribution of parameter change effects will also be presented, as appropriate.

In order to reflect changes in the development of the site and of the vicinity of the site over time, simulations of preslip conditions will also be performed during the second phase of the investigation. The simulations of preslip conditions will be used to help interpret groundwater quality data. In addition to the possible adjustments described above, historical features such as the on-site ponds may be simulated as areal infiltration elements in order to predict their influence on groundwater flow directions and gradients. Similarly, significant changes from current conditions in the size of no infiltration areas (i.e., buildings, parking lots) may also be simulated.

It is anticipated that the MYGRT computer code will be used in Phase II to develop one-dimensional and two-dimensional simulations of solute transport along specific flow paths determined from groundwater elevation data and results of the flow simulations (Barr, 1993). Contaminant source areas will likely be

simulated as constant concentration sources. Simulations will be performed using compound-specific data for transport of chemical constituents of interest.

Contaminant transport simulations will be used to assess observed groundwater quality data. Input data will be varied within defined ranges of representative values in order to best simulate observed conditions. It is likely that the contaminant transport simulations will incorporate significant uncertainties related to source specifications, i.e., the site appears to involve multiple source areas that may have contributed different chemical constituents to the groundwater over different time frames. These uncertainties will be evaluated using sensitivity analyses for relevant parameters. Contaminant transport scenarios for various remedial alternatives will be evaluated, as appropriate.

3.4 GROUNDWATER AND ECOLOGICAL SAMPLING

The objectives of the groundwater and ecological sampling are to:

- Determine the nature and extent of contamination downgradient of source areas identified in the soils investigation;
- Evaluate the spatial distribution of contaminants in groundwater;
- Collect sufficient data to determine whether or not the site poses a threat to potential downgradient receptors; and
- Assist in selection of possible remedial alternatives.

3.4.1 Groundwater Sampling

3.4.1.1 Monitoring Well Groundwater Samples

Two groundwater sampling events will be conducted during Phase II. The first sampling event will take place within approximately one month of the completion of the proposed monitoring wells. During the first sampling event, water quality samples will be collected from each monitoring well installed

during Phase II investigations and from selected existing wells. A second sampling event will be scheduled at least one month after the first. During the second sampling event, samples will be collected from all monitoring wells.

Groundwater samples collected from the Phase II monitoring wells during the first sampling round will be analyzed for the full-scan parameter list to establish an initial groundwater quality characterization. After completion of this sampling event, one sample from each monitoring well will have been analyzed for pesticides, PCBs, metals, volatile organic compounds, and semivolatile organic compounds. During the first sampling event, samples will also be collected from Monitoring Wells MW-6S, MW-6D, MW-7S, MW-7D, MW-9S, MW-9D, MW-10S, MW-10D, MW-12S, and MW-12D and will be analyzed for biochemical oxygen demand (BOD)/chemical oxygen demand (COD), oil and grease, total suspended solids, sulfate, sulfide, chloride, alkalinity, acidity, total hardness, total dissolved solids, and total organic carbon to help evaluate potential treatment alternatives. Groundwater samples collected during the second sampling event will be analyzed for the PAHs listed in Table 2.4-8, VOCs listed in Table 2.4-14, the phenols listed in Table 2.4-8, arsenic (total, +III, +V), cadmium, lead, mercury, selenium, total ammonia, total cyanide, thiocyanate, and weak acid dissociable cyanide. Details of groundwater sampling protocols and analytical methods are included in the October 1991 FSP and QAPP. The laboratory will be requested to report estimated concentrations (J) and to indicate when the criteria for reporting estimated concentrations has not been met. Laboratory standard operating procedures (SOPs) for arsenic (III), arsenic (V), total ammonia, thiocyanate, weak acid dissociable cyanide, sulfate, sulfide, chloride, alkalinity, acidity, total hardness, total dissolved solids, total organic carbon, BOD, and COD are in Appendix K. The Phase II sampling program and sample and analysis program are summarized in Tables 3.2-1 and 3.2-2, respectively. Sample containers, preservation, and holding times are summarized in Table 3.2-3. Monitoring well development water will be treated and returned to the ground using methods described in Section 3.3.4 of this report.

3.4.1.2 HydroPunch Groundwater Samples

One groundwater sample will be obtained from each of the temporary well point locations shown on Figure 3.3-2. Groundwater quality data from these samples will be used to assess potential chemical constituent migration from the site and to provide supplementary information for assessing historical groundwater flow directions. The proposed locations may be revised depending on accessibility and public safety issues. Because these locations are on public beach, temporary well points will be used instead of monitoring wells. Waves, shifting sands, and public access concerns make monitoring wells at these locations infeasible.

The groundwater samples will be obtained using the HydroPunch temporary well point method and hollow-stem auger drilling techniques. Information about the HydroPunch method is in Appendix L. The samples will be collected from depths below the water table that are similar to the screened intervals of the deep on-site monitoring wells. The auger will remain at least 2 feet but less than 5 feet above the sampled interval. Stainless steel well points will be used to collect the samples and clean well points will be used at each boring. The well points and HydroPunch tool will be washed with detergent and potable water and rinsed with potable water between samples. The samples will be collected during the phase of the investigation in which the monitoring wells are installed. The samples will be analyzed for the same parameters analyzed in the second Phase II groundwater sampling event.

Although the HydroPunch samples will contain sediment and although the samples can only be collected once at the proposed locations, the results will directly address the objective of collecting and analyzing these samples (i.e., providing groundwater quality data for evaluating whether past chemical constituent migration in groundwater may have occurred from the site toward the east).

3.4.2 Surface Water Sampling

Lake Michigan is the surface water receptor of primary concern that may be affected by chemical transport from the WCP site. Waukegan Harbor is a surface water receptor and receives groundwater discharging from the WCP site. The harbor is, therefore, a focus for evaluating potential site impacts on Lake Michigan.

Data for evaluating potential impacts on surface water associated with chemical migration from the WCP site will be derived, in part, from the existing data summarized in Section 2.4.5. These data will be supplemented in Phase II by: (1) surface water sampling in the new slip, Waukegan Harbor, and Lake Michigan; and (2) calculations of site impacts on surface water quality, based on groundwater data and contaminant fate modeling for discharges to surface waters.

Surface water samples will be collected from 12 sampling locations in the new slip, Waukegan Harbor, and Lake Michigan. Figure 3.4-1 shows the proposed surface water sampling locations.

The depth at each sampling location will be sounded. Temperature and conductivity will be measured in situ at approximately 3-foot intervals at the sampling locations. At locations where the depth of the water column is greater than 10 feet, water samples will be collected for analysis from two sampling intervals: (1) approximately 2 feet below the surface, and (2) approximately 1½ feet above the bottom of the water body. At locations where the water is less than 10 feet deep, one sample will be collected for analysis from an interval approximately 1½ feet above the bottom of the water body. The Lake Michigan near-shore sampling locations are intended to be collected in water 3 to 4 feet deep.

Depth sounding methods will conform to the SOP for Sounding Depths (Appendix M). Temperature and conductivity measurement methods will conform to the SOP for the Calibration and Operation of the Conductivity and Temperature Meter (Attachment 5B to the October 1991 FSP). Surface water samples will be retrieved using methods that conform to the SOP for Surface Water Sample

Collection (Appendix M). When the water sample has been retrieved, the water will be poured into the appropriate sample container in accordance with the procedures outlined in Attachment 8 of the October 1991 FSP.

The surface water samples will be analyzed for the PAHs listed in Table 2.4-8, VOCs listed in Table 2.4-14, the phenols listed in Table 2.4-8, arsenic (total, +III, +V), cadmium, mercury, selenium, total ammonia, total cyanide, thiocyanate, weak acid dissociable cyanide, total suspended solids, oil and grease, BOD, and COD. Additional existing surface water sample analytical results will be obtained from the City of Waukegan Waterworks and the North Shore Sanitary District.

Chemical constituents reported in surface water samples are expected to reflect the influence of the numerous industrial facilities in the Waukegan Harbor area. Determining relative contributions of the WCP site to the cumulative surface water quality results would be difficult. However, the surface water sampling approach will provide a maximum chemical concentration against which to compare modeled fate and transport results.

Rates of groundwater discharge from the WCP site and corresponding groundwater quality data will also be used to estimate site impacts on surface waters. This approach focuses on site contributions to the harbor rather than possible effects of other industrial sites in the area.

This combination of surface water sampling and chemical fate and transport modeling is an appropriate way to reduce potential uncertainties associated with either approach implemented on its own.

3.4.3 Ecological Sampling

No ecological sampling is recommended for the site at this time. No endangered or threatened ecological receptors were identified on the property during the ecological survey for this site. Potential ecological receptors in proximity to the site include the Waukegan Harbor aquatic habitat, Lake Michigan aquatic habitat, Waukegan Beach dune and beach habitat, the Commonwealth Edison Waukegan Plant common tern nesting colony and the Illinois Beach State Park

dunesland habitat (encompassing beach, dune, prairie and marsh habitats). There is no indication that terrestrial ecological receptors are present at the site.

Contamination to Waukegan Harbor from sources other than the site is well documented. The ecological receptors for exposure to contaminants from the site may be the areas within Lake Michigan which are impacted by the outflow from the Harbor.

Sediment sampling will not be performed in Phase II due to the following interferences that would prevent the interpretation of meaningful relationships between sediment quality data and potential impacts of the WCP site: (1) much of Waukegan Harbor was recently dredged as part of the OMC PCB cleanup and, as a result, current sediment quality would reflect impacts of the dredging rather than impacts of past discharges from the WCP site and other sources; and (2) sediment quality in Lake Michigan would reflect the influences of numerous regional sources of chemical constituents and would, therefore, be most appropriately addressed as part of a regional study of the harbor/Lake Michigan area.

3.5 REMEDIAL TECHNOLOGY EVALUATION PROGRAM

Sampling will be performed during Phase II for evaluation of selected remedial technologies and for evaluation of potential remedial actions at the site. The purpose of the general remediation evaluation sampling and analysis is to collect information that will be useful in evaluating the appropriateness and effectiveness of potential remedies. Some of the parameters relate to groundwater flow and contaminant fate and transport, others relate to classifying and characterizing soil.

In addition to the general remedial evaluation sampling and analysis, four soil treatment technologies, two containment technologies, and one water treatment technology will be evaluated in this program. The soil treatment technologies are: biological treatment, thermal desorption, cement kiln incineration, and soil washing. The containment technologies are: slurry wall and capping. The water treatment technology is electrochemical precipitation. The purpose of the remedial technology evaluations will be to assess the

viability of the technology for application at the WCP site and to provide information to supplement literature estimates of the cost of implementing the technology. These evaluations are not intended to be treatability studies, but may be used to select a particular technology for a treatability study, which would be performed for remedial design.

Samples will be collected from source areas for soil treatment technology evaluation. Samples from areas with little or no visible impacts will be collected for containment technology evaluation. Remedial technology evaluation samples may be collected from auger cuttings or test excavations. Samples for water treatment technology evaluation will be collected during water treatment activities.

The soil treatment and containment technology evaluations will include supplying a vendor with a sample from the site, and performance by the vendor of specific tests to demonstrate the applicability and potential effectiveness of their technology. Vendor proposals will be solicited during the Phase II investigation support work. Where applicable, technology effectiveness will be checked by analysis of split samples of treated and untreated soil. The U.S. EPA will be kept informed of the details of the technology evaluation program by copy of the scopes of work agreed with the selected vendors.

The basic soil and groundwater characterization needed for evaluation of potential remedial technologies are included in the site remedial investigation. Much of the contaminant characterization needed for several of these technologies has already been adequately performed during the Phase I and previous investigations. Additional parameters may be analyzed by vendors as part of their work. The results of those analyses will be in their reports, which will be included in the Feasibility Study.

Evaluation of other technologies will be by review of literature, consultation with vendors and suppliers, and previous experience.

The following sections present the general remediation evaluation parameters, then briefly describe each of the treatment and containment technologies to be evaluated in this program, including comments on the

potential application of these technologies at the site, and the factors involved in their evaluation.

3.5.1 General Remediation Evaluation Parameters

In order to determine soil engineering properties and characteristics that will direct remedial alternatives screening of several different treatment and containment technologies, soil samples will be collected for tests according to the schedule described below and summarized in Table 3.2-1.

- Corrosivity and Reactivity: The soil samples collected from the depth interval of 2 to 4 feet from the borings located near the thionizer building and sulfur pile will be analyzed for corrosivity and reactivity.
- Grain Size Distribution: Three samples of the surficial sand unit and three samples of the clay till unit will be selected to be representative of the hydrostratigraphic units based on the results of the soil classification and to be areally representative of the site. At least one surficial sand unit sample will be tested using a wet sieve analysis. Additional samples will also be submitted to characterize the siltier sands that were present in some borings at the bottom of the sand unit.
- Atterberg Limits: Atterberg limits tests will be performed on the three samples of the till unit that will be submitted for analysis of grain size distribution. Samples of the fill will also be tested for Atterberg limits if appropriate.
- Porosity: Three samples of the surficial sand unit and three samples of the clay till will be submitted for porosity tests. The samples will be selected to be representative of the hydrostratigraphic units based on the results of the soil classification and to be areally representative of the site.

- Total Organic Carbon: Three samples of the clay till unit and three samples of the surficial sand unit will be submitted for analysis of total organic carbon. Additional samples from siltier units may also be submitted if appropriate. The samples will be selected to be representative of the units based on the results of the soil classification and to be aerially representative of the site. These samples will not be collected from visibly contaminated areas.

- Cation Exchange Capacity: Three samples of the clay till unit and three samples of the surficial sand unit will be submitted for analysis of cation exchange capacity. Additional samples from siltier units may also be submitted if appropriate. The samples will be selected to be representative of the units based on the results of the soil classification and to be aerially representative of the site. These samples will not be collected from visibly contaminated areas.

- Vertical Permeability: Three samples of the clay till unit will be selected for vertical permeability testing. They will be selected to be representative of the unit and to give areal representation of the site.

- TCLP: Four soil samples will be collected for analysis by TCLP. Three samples will be collected above groundwater: one from within the northeast pond area and two oily and/or tarry samples from the former processing area. One oily and/or tarry sample will be collected below groundwater in the former processing area. Prior to packaging in laboratory containers, TCLP samples will be prepared in a manner intended to represent the size sorting, mixing, and processing the material would undergo prior to treatment by a remedial technology. The sample preparation will consist of placing the sample material in a stainless steel bowl, removing objects larger than 1/2 inch in size, and mixing for one minute.

- Gross Heating Value (BTU/lb) and Oil and Grease: One sample for analysis of gross heating value and one for oil and grease analysis

will be collected from each of the three areas in which contaminants are concentrated at the site (based on the Phase I field screening and analytical results).

- Flashpoint: One sample for analysis of flashpoint will be collected at each location sampled for gross heating value (BTU/lb) and oil and grease.

Samples to be analyzed for permeability will be collected with a Shelby tube sampler in accordance with ASTM D-1587 Standard Practice for Thin-Walled Tube Sampling of Soils. Samples to be submitted for analyses of corrosivity, reactivity, total organic carbon, cation exchange capacity, oil and grease, gross heating value, and flashpoint will be packaged in clean sample containers. Samples to be submitted for the remaining geotechnical analyses will be selected upon completion of the soil boring program.

The analytical methods for the geotechnical analyses are described in Section 4.2.5 of the October 1991 FSP. The standard operating procedure for cation exchange capacity is in Appendix K. Soil sampling and handling procedures are described in detail in the FSP and QAPP.

3.5.2 Biological Treatment

Biological treatment can be useful for reducing the concentration of organic concentrations in soil or groundwater. This technology generally has little effect on four and higher number ring PAHs, but the effectiveness can be enhanced with chemical treatments. Biological treatment can significantly reduce total PAH, phenolics, and volatiles concentrations, resulting in reduced mobility for the higher number ring PAHs. Because the treatment endpoint for coal tars is generally dependent on the initial concentration, the target concentration of PAHs in soil will be very important in determining the usefulness of biological treatment for the site soils. The treatment test will use soil from below groundwater and will be oriented toward assessing in situ bioremediation, although the potential use of this technology is not being limited to in situ applications. One sample each of the untreated and treated

soils will be split with the vendor and analyzed for the Phase II PAHs, phenolic compounds, BETX, and inorganic compounds in Table 2.4-8.

A number of the factors that influence bioremediation effectiveness for groundwater will be evaluated for groundwater samples during the Phase II work. These factors include aquifer characteristics, contaminant transport-related parameters, and groundwater chemistry (i.e., general chemistry parameters such as sulfate, sulfide, chloride, alkalinity, acidity, total hardness, total dissolved solids, total organic carbon, biological oxygen demand, and chemical oxygen demand).

3.5.3 Thermal Desorption

Thermal desorption is an effective technology for cleaning soil contaminated with semivolatile organics. The effectiveness and cost-effectiveness of the technology can decline as concentrations of organics approach levels that are suitable for use as fuel. The presence of volatile metals can render this technology unsuitable. Significant factors influencing the cost of this technology include soil type, moisture content, and contaminant volatility. One sample each of the untreated and treated soils will be split with the vendor and analyzed for the Phase II PAHs, phenolic compounds, BETX, and inorganic compounds in Table 2.4-8. The vendor may test for other parameters related to implementation of this technology.

3.5.4 Cement Kiln Incineration

Cement kiln incineration is effective in destroying PAHs and other organics, and is most applicable for soils and sludges possessing more than 6,000 BTU/lb (expected to be about 15 percent PAHs). The waste characterization parameters generally required for cement kiln treatment are heat content (BTU/lb), ash content, moisture content, pH, percent sulfur, halogens, PCBs, pesticides, heavy metals, fluorides, radioactivity, volatiles, percent chlorine, and flashpoint. One sample of untreated soil will be analyzed for heat content and the Phase II PAHs, phenolic compounds, BETX, and inorganic parameters in Table 2.4-8. The specific parameters the vendor will analyze may vary, depending upon the vendor's needs and permit requirements.

3.5.5 Soil Washing

Soil washing is a potentially suitable technology for sandy soil containing organics, which is the case at the WCP site. The target concentration of PAHs in soil is very important in determining the usefulness of soil washing, as the technology does not generally achieve high removal efficiencies. Particle size distribution, contaminant partition coefficients, metals concentration, humic acid content, pH, cation exchange capacity, and buffering capacity can all affect soil washing effectiveness. One sample each of the untreated and treated soils will be split with the vendor and analyzed for the Phase II PAHs, phenolic compounds, BETX, and inorganic compounds in Table 2.4-8. The vendor may analyze and report other parameters as well.

3.5.6 Slurry Walls

The slurry wall technology is well suited to this site because of the relatively shallow depth to a till confining unit and the effectiveness of a slurry wall containment system to confine both soil and groundwater. Parameters that are important in slurry wall evaluation include engineering and physical properties of the soil and the till, which will be obtained in the grain size distribution, Atterberg limits, permeability testing, and other soil analyses performed in Phase II. Preliminary mix designs and an assessment of the influence of the groundwater quality on potential slurry mixes will be evaluated in this test program. The slurry wall design prepared for the Waukegan Harbor Trust containment cells will be reviewed for relevant information.

3.5.7 Capping

Capping is useful for reducing infiltration through and leachate production from the underlying unsaturated soil. Capping also minimizes the potential for human exposure to the capped materials. Used in conjunction with a slurry wall containment cell at this site, capping would reduce the need for groundwater removal within the cell and would provide the upper barrier which completes the containment system. Capping is a proven, widely used technology. Information to be used in evaluation of cap design will include: grain size distribution, porosity, and relative density from sampler blow counts during boring placement.

The cap designs prepared for Waukegan Harbor Trust containment cells will be reviewed for relevant information.

3.5.8 Water Treatment

During the field investigation, groundwater from the pump test and from well development will be treated on-site using electrochemical precipitation prior to discharge. This system is designed to remove arsenic by reaction with iron and peroxide to form arsenate. The system also complexes cyanide with iron. The arsenic and cyanide are removed as precipitates in a flocculation and settling process. Fenton's reagent (formed from iron and peroxide) has been shown effective at chemically breaking aromatic compounds like PAHs, suggesting this technology may be useful for treating organics at the site as well.

Three sets of influent and effluent samples will be collected during treatment of the water on-site. Samples will be collected with the system in two configurations. Two sets of samples will be collected with the activated carbon unit upstream of the electrochemical precipitator. One set of samples will be collected without the activated carbon unit in line. All of these samples will be analyzed for the phenolic compounds in Table 2.4-8, the PAH compounds in Table 2.4-8, BETX, arsenic, cyanide (total and weak acid dissociable), thiocyanate, cadmium, lead, mercury, selenium, and total ammonia. This data will be used to evaluate the potential effectiveness and cost of this technology for remedies involving groundwater pump-out and treatment.

3.6 PROJECT SCHEDULE

The revised project schedule is presented in Tables 3.6-1 and 3.6-2. This schedule replaces the schedule presented in the Work Plan and replaces Revision 1 of the schedule submitted with the April 3, 1992 Monthly Progress Report.

3.6.1 Revised Schedule

The project schedule, second revision, is shown in Table 3.6-1. The schedule begins with February 26, 1992, when the Phase I activities formally began. For the period up to the projected submittal of the revised Phase I Technical Memorandum on April 13, 1993, Table 3.6-1 shows actual dates and durations for the various work elements. From April 14, 1993 to the completion of the project, the table shows projected dates and task durations. The cumulative duration column shows the total number of weeks since the project began, counting March 7, 1992 as the end of the first week.

The revised schedule for the remainder of the project is illustrated in Table 3.6-2. The table illustrates the overlap of activities. A number of the activities in this ambitious schedule are interlinked, so that delay in completion of any activity may result in slippage of the entire schedule.

3.6.2 Submittals Requiring U.S. EPA Approval

There are four submittals which require U.S. EPA approval. They are:

- RI/FS Phase I Technical Memorandum;
- Preliminary Characterization Summary;
- Remedial Investigation Report; and
- Feasibility Study Report.

The revised RI/FS Phase I Technical Memorandum, including the Phase II Work Plan, is being submitted to the U.S. EPA on April 13, 1993. The attached schedule assumes U.S. EPA approval of that submittal on or before May 14, 1993.

The Preliminary Characterization Summary will consist of the laboratory and field data from the Phase II investigation, and will include the locations of sample collection. The purpose of providing this report is to allow the risk assessment to proceed in a timely manner.

In accordance with direction from the U.S. EPA during preparation of the Work Plan, some U.S. EPA review schedules are very short. Extension of U.S. EPA

review times beyond those indicated will result in equal extensions in the total project time.

3.6.3 Submittals for U.S. EPA Comment

Submittals shown under Tasks VII and VIII are submitted to the U.S. EPA for comment, but not for approval. The Tech Memos developed during these tasks will be incorporated into the Feasibility Study and, therefore, the Tech Memos will not be revised and resubmitted following U.S. EPA comment. U.S. EPA review of these documents is not formally required, but the intent of submittal of these Tech Memos is to provide the U.S. EPA with an early opportunity to review the progress and orientation of the Feasibility Study and to provide comments, assistance, and guidance, as appropriate.

Although no schedule is shown for U.S. EPA review of these Tech Memos, it is very important that if the U.S. EPA desires to comment on a Tech Memo, those comments be provided within two weeks of the submittal of the Tech Memo. The urgency of prompt comments is apparent, considering the schedule provides only one month from submittal of the last Tech Memo, Comparative Analysis of Alternatives, to submittal of the draft Feasibility Study Report.

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Tables

TABLE 1.4-1
POTENTIAL CHEMICALS OF CONCERN
MANUFACTURED GAS PLANT SITES

PURIFICATION PROCESS	COAL ASH	COAL TAR		
INORGANICS	METALS	VOLATILE AROMATICS	PHENOLICS	POLYNUCLEAR AROMATIC HYDROCARBONS
Ammonia	Aluminum	Benzene	Phenol	Acenaphthene
Cyanide	Antimony	Ethyl Benzene	2-Methylphenol	Acenaphthylene
Nitrate	Arsenic	Toluene	4-Methylphenol	Anthracene
Sulfate	Barium	Total Xylenes	2,4-Dimethylphenol	Benzo(a)anthracene
Sulfide	Cadmium			Benzo(a)pyrene
Thiocyanates	Chromium			Benzo(b)fluoranthene
	Copper			Benzo(g,h,i)perylene
	Iron			Benzo(k)fluoranthene
	Lead			Chrysene
	Manganese			Dibenzo(a,h)anthracene
	Mercury			Dibenzofuran
	Nickel			Fluoranthene
	Selenium			Fluorene
	Silver			Naphthalene
	Vanadium			Phenanthrene
	Zinc			Pyrene
				2-Methylnaphthalene

Source: GRI, 1987. "Management of Manufactured Gas Plant Sites, Volume I."

TABLE 1.4-2

MAJOR CONSTITUENTS OF COAL TAR, PER FISHER (1938)^{a,b}
(Percentages Based on the Original Tar)

	MAJOR FRACTION	FRACTION	SUBFRACTION
Coal Tar			
Light Oil, up to 200°C	5.0	--	--
Benzene	--	0.1	--
Toluene	--	0.2	--
Xylenes	--	1.0	--
Heavy solvent naphtha		1.5	--
Middle Oil, 200-250°C	17.0	--	--
Tar Acids	--	2.5	--
Phenol	--	--	0.7
Cresols	--	--	1.1
Xylenols	--	--	0.2
Higher tar acids	--	--	0.5
Tar Bases	--	2.0	--
Pyridine	--	--	0.1
Heavy bases	--	--	1.9
Naphthalene	--	10.9	--
Unidentified	--	1.7	--
Heavy Oil, 250-300°C	7.0	--	--
Methylnaphthalenes	--	2.5	--
Dimethylnaphthalenes	--	3.4	--
Acenaphthene	--	1.4	--
Unidentified	--	1.0	--
Anthracene Oil, 300-350°C	9.0	--	--
Fluorene	--	1.6	--
Phenanthrene	--	4.0	--
Anthracene	--	1.1	--
Carbazole	--	1.1	--
Unidentified	--	1.2	--
Pitch	62.0	--	--
Gas	--	2.0	--
Heavy oil	--	21.8	--
Red wax	--	7.0	--
Carbon	--	32.0	--

Source: Utility Solid Waste Activities Group, 1984.

^aReproduced from Wilson & Wells (1950, p. 374) and referenced from Shreve, 1945 (p. 91).

^bAlso reported in Gas Engineers Handbook (1966, p. 3/17) and referenced as being obtained from Fisher, 1938.

TABLE 1.4-3

COMPARISON OF THE PHYSICAL PROPERTIES
OF COAL TAR AND CREOSOTE

	CREOSOTE ^a	CREOSOTE ^b	COKE OVEN ^c COAL TAR
Benzene insoluble, % wt.		0.99	4.6
Distillation, % wt.			
Up to 210°C	2	1.87	1.8
235°C	12	6.89	7.1
270°C	20-40	19.39	18.2
315°C	45-65	49.8	28.3
355°C	65-82	72.58	41.9
Residue above 355°C		26.67	57.6
Specific gravity		1.10	1.18

^aAmerican Wood-Preservers' Association Standards (Pl-65) for land and freshwater use.

^bLorenz and Sjovik, 1972.

^cMartin, 1949.

TABLE 2.2-1
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
Potential Source Area Investigation Samples						
SC-01	03/07/92	--	2.0-4.0	1.5	N	N
SC-02	03/07/92	--	2.0-4.0	0	N	N
TT-01-01	03/06/92	0+25	2.5	0	T	N
TT-01-02	03/06/92	0+50	4.0	23	M	M
TT-01-03	03/06/92	1+15	2.0	1	M	N
TT-01-04	03/06/92	1+30	6.0	80	M	S
TT-01-05	03/09/92	2+00	3.0	1	N	M
TT-02-01	03/05/92	0+05	2.0	6.5	N	N
TT-02-02	03/05/92	0+35	2.0	0.5	N	N
TT-02-03	03/05/92	0+55	2.0	23	N	N
TT-02-04	03/05/92	1+15	2.5	90	M	L
TT-02-05	03/05/92	1+50	2.0	0.5	N	M
TT-02-06	03/05/92	1+25	2.5	--	--	--
TT-02-09	03/05/92	1+35	1.0	--	--	--
TT-02-10	03/05/92	1+45	1.0	--	--	--
TT-03-01	03/10/92	0+50	4.0	22	H	S
TT-03-02	03/10/92	1+30	4.0	5	T	L
TT-03-03	03/11/92	1+80	4.0	1	N	N
TT-03W-01	03/13/92	0+50	4.0	99	H	S
TT-03W-02	03/13/92	1+33	3.5	630	H	S
TT-03W-01A	03/20/92	2+05	2.0	0	N	--
TT-03W-02A	03/20/92	2+05	4.0	3	N	--
TT-04-01	03/05/92	0+05	4.0	0.5	N	N
TT-04-02	03/05/92	0+40	4.5	3.0	M	N
TT-04-03	03/05/92	0+40	6.0	--	--	--
TT-05-01	03/09/92	0+30	5.0	2	H	D
TT-05-02	03/09/92	0+40	4.5	21	H	D
TT-05E-01	03/10/92	1+10	5.0	0	N	N
TT-06-01	03/09/92	0+15	4.0	1	M	N
TT-06-02	03/09/92	0+40	4.5	9	H	S
TT-06-03	03/09/92	0+60	4.5	10	N	D
TT-06-04	03/09/92	0+30	2.5	0.5	N	N
TT-07-01	03/19/92	0+10	4.5	38	N	N
TT-07-02	03/19/92	0+28	2.5	0	N	N
TT-07-03	03/19/92	0+80	4.5	150	H	P
TT-08-01	03/21/92	0+15	3.0	45	M	L
TT-08-02	03/21/92	0+10	4.0	40	H	S
TT-08A-01	03/21/92	0+05	5.0	7	N	U
TT-08A-02	03/21/92	0+45	3.0	430	M	N

TABLE 2.2-1 (Cont.)
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
TT-09-01	03/11/92	0+25	5.0	2	N	N
TT-09-02	03/11/92	0+60	6.0	9	N	N
TT-10-01	03/21/92	0+13	7.0	3,440	H	M
TT-10-02	03/21/92	0+40	4.0	4,740	H	S
TT-11-01	03/18/92	0+40	2.5	800	H	S
TT-11-02	03/18/92	0+30	4.0	1,250	H	S
TT-12-01	03/18/92	0+40	4.0	1,700	H	S
TT-12-02	03/18/92	0+10	4.0	3,675	H	S
TT-12-03	03/18/92	0+25	1.0	0	N	N
TT-13-01	03/16/92	0+15	4.5	0	N	N
TT-13-02	03/16/92	0+30	4.5	0	N	N
TT-14-01	03/18/92	0+30	4.0	660	H	S
TT-14-02	03/18/92	0+40	4.0	800	H	S
TT-14-03	03/18/92	--	4.0	330	H	S
TT-14-04	03/18/92	--	4.0	70	H	--
TT-15-01	03/17/92	0+30	5.5	750	H	S
TT-15-01A	03/20/92	0+50	5.0	750	H	S, P
TT-16-01	03/12/92	0+44	4.5	0	M	L
TT-16-02	03/12/92	0+18	4.5	3.5	N	L
TT-17-01	03/12/92	0+15	4.5	38	N	N
TT-17-02	03/12/92	0+50	4.5	0	N	N
TT-18-01	03/17/92	0+27	4.0	200	M	S
TT-19-01	03/17/92	0+65	4.5	2,000	H	S
TT-19W-01	03/17/92	0+30	4.5	50	N	N
TT-19W-01A	03/20/92	1+47	2.0	130	H	S
TT-19W-02A	03/20/92	1+47	3.5	3,500	H	S
TT-19W-03A	03/20/92	1+49	3.0	500	H	S
TT-20-01	03/16/92	0+42	3.0	1	M	M
TT-21-01	03/16/92	0+10	4.5	0	N	N
TT-21-02	03/16/92	0+45	3.5	0	T	M
TT-22-01	03/12/92	0+60	3.5	0.5	N	N
TT-22N-01	03/12/92	0+60	3.5	7	N	N
TT-23-01	03/19/92	0+10	2.0	0	N	N
TT-23-02	03/19/92	0+10	5.0	800	H	S
TT-23-03	03/19/92	0+40	4.0	8,015	H	P
TT-00C-01	03/20/92	0+40	3.5	90	--	--
TT-00C-02	03/20/92	0+85	3.5	1	--	--

TABLE 2.2-1 (Cont.)
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
Background Soil Samples						
BS-01	03/05/92	--	2.0-4.0	0	N	N
BS-02	03/05/92	--	2.0-4.0	2	N	N
BS-03	03/05/92	--	2.0-4.0	2	N	N
BS-04	03/05/92	--	2.0-4.0	0	N	N
BS-05	03/25/92	--	2.0-4.0	1	N	N
BS-06	03/25/92	--	2.0-4.0	0	N	N
BS-07	03/25/92	--	2.0-4.0	75	N	N
BS-08	03/25/92	--	2.0-4.0	3	N	N
Surficial Soil Samples						
SS-01	03/10/92	-----	0-2.0	--	N	N
	03/10/92		2.0-4.0	4	T	N
SS-02	03/06/92	--	2.0-4.0	0.5	N	N
SS-03	03/06/92	--	2.0-4.0	42	N	N
SS-04	03/06/92	--	2.0-4.0	8	N	N
SS-05	03/06/92	--	2.0-4.0	150	N	N
SS-06	03/11/92	--	0-2.0	--	--	N
	03/11/92	--	2.0-4.0	11	M	N
SS-07	03/10/92	--	2.0-4.0	0	T	L
SS-08	03/11/92	--	2.0-4.0	2	T	N
SS-09	03/11/92	--	2.0-4.0	0	N	N
SS-10	03/11/92	--	2.0-4.0	2	T	N
SS-11	03/11/92	--	2.0-4.0	0	N	N
SS-12	03/11/92	--	2.0-4.0	0	N	N
SS-13	03/12/92	--	2.0-4.0	6	N	N
SS-14	03/12/92	--	2.0-4.0	6	T	N
SS-15	03/07/92	--	2.0-4.0	0	N	N
SS-16	03/07/92	--	0-2.0	--	T	N
	03/07/92	--	2.0-4.0	0.5	N	N
SS-17	03/07/92	--	0-2.0	--	T	N
	03/07/92	--	2.0-4.0	1	N	N

TABLE 2.2-1 (Cont.)
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
Pilot Boring and Piezometer Soil Samples						
SB-03 ¹	03/16/92- 03/18/92	--	0-2.0	0 ¹	N	N
		--	2.0-4.0	2.4 ¹	N	N
		--	4.0-6.0	6.2 ¹	N	N
		--	6.0-8.0	30 ¹	N	N
		--	8.0-10.0	90 ¹	N	N
		--	10.0-12.0	34 ¹	N	N
		--	12.0-14.0	8 ¹	N	N
		--	14.0-16.0	6 ¹	N	N
		--	16.0-18.0	160 ¹	N	L
		--	18.0-20.0	760 ¹	N	M
		--	20.0-22.0	>1,000 ¹	N	M
		--	22.0-24.0	>1,000 ¹	N	M
		--	24.0-26.0	>1,000 ¹	N	M
		--	26.0-28.0	>1,000 ¹	N	L
		--	28.0-30.0	>1,000 ¹	N	M
		--	30.0-32.0	28 ¹	N	N
		--	32.0-34.0	62 ¹	N	N
		--	34.0-36.0	5.7 ¹	N	N
		--	39.0-41.0	0 ¹	N	N
		--	44.0-46.0	>1,000 ¹	N	N
		--	54.0-56.0	40 ¹	N	N
		--	64.0-66.0	90 ¹	N	N
		--	74.0-76.0	10 ¹	N	N
		--	84.0-86.0	8 ¹	N	N
		--	94.0-96.0	54 ¹	N	N
		--	104.0-106.0	6 ¹	N	N
MW-3D	03/18/92	--	26.0-28.0	160	N	L

¹Headspace concentrations for SB-03 recorded under the nonmethane headspace column are total organic vapor headspace concentrations, including methane. At adjacent Pilot Boring MW-3D, the total headspace reading was 820, but the nonmethane headspace was only 160 ppm.

TABLE 2.2-1 (Cont.)
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
SB-04	03/20/92	--	0-2.0	2	N	N
		--	2.5-4.5	2	N	N
		--	5.0-7.0	10	N	N
		--	7.5-9.5	0	N	N
		--	10.0-12.0	26	N	N
		--	12.5-14.5	75	N	N
		--	15.0-17.0	21	N	N
		--	17.5-19.5	24	N	N
		--	20.0-22.0	7	N	N
		--	22.5-24.5	250	N	N
		--	25.0-27.0	1,000	N	M
		--	27.5-29.5	500	N	M
		--	30.0-32.0	1,250	N	M
SB-05	03/23/92	--	0-5.0	0	N	N
		--	5.0-7.0	20	N	N
		--	7.5-9.5	5	N	N
		--	10.0-12.0	15	N	N
		--	12.5-14.5	9	N	N
		--	15.0-17.0	30	N	N
		--	17.5-19.5	12	N	N
		--	20.0-22.0	50	N	N
		--	22.5-24.5	80	N	N
		--	25.0-27.0	75	N	N
SB-06	03/24/92	--	2.5-4.5	0	N	N
		--	5.0-7.0	3	N	N
		--	7.5-9.5	4	N	N
		--	10.0-12.0	0	N	L
		--	12.5-14.5	50	N	L
		--	15.0-17.0	10	N	L
		--	17.5-19.5	75	N	L
		--	20.0-22.0	250	N	L
		--	22.5-24.5	150	N	M
		--	25.0-27.0	200	N	L
P-101	03/09/92	--	4.0-5.0	--	N	N
			10.0-12.0	--	N	N
P-102	03/12/92	--	0-2.0	--	N	N
			4.0-5.0	--	N	N
			11.5-12.5	--	T	L

TABLE 2.2-1 (Cont.)
FIELD SCREENING RESULTS

SAMPLE NO.	SAMPLE DATE	STATION	DEPTH (FT)	NONMETHANE HEADSPACE (PPM)	OIL SHEEN	ODOR
P-103	03/12/92- 03/13/92	--	0-1.0	--	N	N
		--	4.0-5.0	--	N	N
		--	7.0-8.0	--	N	N
		--	12.0-13.0	--	N	N
P-104	03/12/92	--	0-2.5	--	T	N
		--	2.5-5.0	--	M	L
		--	7.0-8.0	--	T	L
		--	12.0-13.0	--	T	N

Oil Sheen Test Results

N = None
T = Trace
M = Moderate
H = Heavy
-- = Not Tested

Odor Test Results

N = None
L = Low Coal Tar Odor
M = Moderate Coal Tar Odor
S = Strong Coal Tar Odor
V = Very Strong Coal Tar Odor

D = Diesel Odor
P = Petroleum Odor
U = Sulfur
-- = Not Tested

TABLE 2.2-2

SOIL SAMPLES SUBMITTED FOR LABORATORY ANALYSIS

SAMPLE NO.	DATE COLLECTED	DEPTH (FT)	PARAMETERS ANALYZED					
			INORGANICS	VOC	SEMIVOLATILES	PAH	PHENOLICS	PEST/PCB
SC-01	03/07/92	2.0-4.0	X	X	X			X
SC-02	03/07/92	2.0-4.0	X	X	X			X
TT-01-02	03/06/92	4.0		X		X(D)	X(D)	
TT-02-04	03/05/92	2.5		X				
TT-02-06	03/05/92	2.5				X	X	
TT-02-09	03/05/92	1.0				X	X	
TT-03-01	03/10/92	4.0	X(A)	X		X		
TT-03-02	03/10/92	4.0		X		X	X	
TT-03-03	03/11/92	4.0		X		X		
TT-03W-01	03/13/92	4.0	X(A)	X		X	X	
TT-03W-02	03/13/92	3.5	X	X	X			X
TT-04-03	03/05/92	6.0				X	X	
TT-05E-01	03/10/92	5.0		X		X		
TT-06-02	03/09/92	4.5	X	X	X			X
TT-06-04	03/09/92	2.5	X	X	X			X
TT-07-01	03/19/92	4.5	X					
TT-07-03	03/19/92	4.5		X		X	X	
TT-08-02	03/21/92	4.0		X		X	X	
TT-08A-01	03/21/92	5.0	X(A)	X				
TT-09-02	03/11/92	6.0		X		X		
TT-10-01	03/21/92	7.0	X(A,D)	X		X(D)	X(D)	
TT-12-01	03/18/92	4.0		X		X	X	
TT-13-01	03/16/92	4.5		X		X		
TT-14-02	03/18/92	4.0	X	X	X			X

TABLE 2.2-2 (Cont.)
SOIL SAMPLES SUBMITTED FOR LABORATORY ANALYSIS

SAMPLE NO.	DATE COLLECTED	DEPTH (FT)	PARAMETERS ANALYZED					
			INORGANICS	VOC	SEMIVOLATILES	PAH	PHENOLICS	PEST/PCB
TT-15-01	03/17/92	5.5		X(D)		X		
TT-16-02	03/12/92	4.5		X		X		
TT-17-01	03/12/92	4.5		X		X	X	
TT-19-01	03/17/92	4.5		X		X		
TT-21-01	03/16/92	4.5		X		X		
TT-22-01	03/12/92	3.5		X(D)				
TT-23-03	03/19/92	4.0		X				
BS-01	03/05/92	2.0-4.0	X	X	X			X
BS-02	03/05/92	2.0-4.0	X	X	X			X
BS-03	03/05/92	2.0-4.0	X	X	X			X
BS-04	03/05/92	2.0-4.0	X	X	X			X
BS-05	03/05/92	2.0-4.0	X	X	X			X
BS-06	03/25/92	2.0-4.0	X(D)	X(D)	X(D)			X(D)
BS-07	03/25/92	2.0-4.0	X	X	X			X
BS-08	03/25/92	2.0-4.0	X	X	X			X
SS-01	03/10/92	2.0-4.0	X	X	X			X
SS-02	03/06/92	2.0-4.0	X(D)	X(D)	X(D)			X(D)
SS-03	03/06/92	2.0-4.0	X	X	X			X
SS-04	03/06/92	2.0-4.0	X	X	X			X
SS-05	03/06/92	2.0-4.0	X	X	X			X
SS-06	03/11/92	2.0-4.0	X	X	X			X
SS-07	03/10/92	2.0-4.0	X	X	X			X
SS-08	03/11/92	2.0-4.0	X	X	X			X
SS-09	03/11/92	2.0-4.0	X	X	X			X

TABLE 2.2-2 (Cont.)
SOIL SAMPLES SUBMITTED FOR LABORATORY ANALYSIS

SAMPLE NO.	DATE COLLECTED	DEPTH (FT)	PARAMETERS ANALYZED					
			INORGANICS	VOC	SEMIVOLATILES	PAH	PHENOLICS	PEST/PCB
SS-10	03/11/92	2.0-4.0	X	X	X			X
SS-11	03/11/92	2.0-4.0	X	X	X			X
SS-12	03/11/92	2.0-4.0	X	X	X			X
SS-13	03/12/92	2.0-4.0	X	X	X			X
SS-14	03/12/92	2.0-4.0	X	X	X			X
SS-15	03/12/92	2.0-4.0	X	X	X			X
SS-16	03/07/92	2.0-4.0	X	X	X			X
SS-17	03/07/92	2.0-4.0	X	X	X			X
SB-04-03	03/20/92	30.0-32.0		X		X	X	
SB-06-01	03/24/92	22.5-24.5		X		X	X	
MW-30	03/18/92	26.0-28.0		X		X	X	

VOC Volatile Organic Compounds
PAH Polynuclear Aromatic Hydrocarbons
PEST Pesticides
PCB Polychlorinated Biphenyls
(A) Arsenic and Cyanide Only
(D) Duplicate

TABLE 2.2 - 3

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
INORGANICS

(concentrations in mg/kg)

	SC01	SC02	TT0301	T03W01	T03W02	TT0602
	03/07/92	03/07/92	03/10/92	03/13/92	03/13/92	03/09/92
Aluminum	1260 J	3540 J	--	--	1270	945
Antimony	2.7 UJ	3.1 UJ	--	--	2.5 R	3.9 BJ
Arsenic	0.60 UJ	61.6 J	360	236	20.6	0.92 B
Barium	8.7 BJ	58.1 J	--	--	8.9 B	3.2 B
Beryllium	0.08 U	1.6	--	--	0.15 U	0.13 BJ
Cadmium	0.73 U	0.83 U	--	--	0.68 UJ	0.67 U
Calcium	32000	35400	--	--	29600	18700
Chromium, total	6.2 U	9.2	--	--	6.1	3.5 U
Cobalt	1.8 B	4.4 B	--	--	2.2 B	1.6 J
Copper	5.9 B	21.9	--	--	8.7	5.8
Iron	3010	5040	--	--	4420	2700
Lead	3.0	8.1	--	--	40.7 J	1.8 J
Magnesium	15400	15400	--	--	15300	9420
Manganese	147	74.9	--	--	138 J	88.3
Mercury	0.07 U	0.09 U	--	--	0.080	0.08 U
Nickel	3.0 B	11.9	--	--	3.7 U	4.2 B
Potassium	288 B	244 B	--	--	166 U	162 U
Selenium	0.32 UJ	0.36 UJ	--	--	3.8 J	0.30 B
Silver	0.43 U	0.49 U	--	--	0.40 U	0.39 U
Sodium	390 U	464 U	--	--	3200	274 UJ
Thallium	0.41 U	0.47 U	--	--	0.25 UJ	0.25 U
Vanadium	5.0 B	13.7 B	--	--	6.7 B	5.5 B
Zinc	19.8	17.7	--	--	41.0	80.5
Cyanide	--	--	8.0 J	956	--	--

	TT0604	TT0701	T08A01	TT1001	TT1402
	03/09/92	03/19/92	03/21/92	03/21/92 SAMPLE	03/18/92 DUPLICATE
Aluminum	3230	637	--	--	7860
Antimony	2.9 BJ	73.5 J	--	--	2.7 R
Arsenic	6.5	1820	304	191	318
Barium	23.4 B	2.0 B	--	--	57.4
Beryllium	1.8 J	0.08 B	--	--	0.38 U
Cadmium	0.68 U	1.6 J	--	--	4.4 J
Calcium	25000	14400	--	--	23700
Chromium, total	4.2 U	13.7	--	--	15.6
Cobalt	14.8 J	0.95 B	--	--	7.9 B
Copper	68.3	24.5	--	--	20.8
Iron	4370	1960	--	--	16300
Lead	11.5 J	19.0 J	--	--	15.3 J
Magnesium	14700	1650	--	--	14700
Manganese	61.1	27.6 J	--	--	384 J
Mercury	0.09 U	5.6 J	--	--	0.24 J
Nickel	15.7	3.5 B	--	--	16.2
Potassium	165 U	173 U	--	--	777 B
Selenium	1.9	1.5 UJ	--	--	4.2 J
Silver	0.40 U	0.42 U	--	--	0.43 U
Sodium	286 UJ	246 U	--	--	319 U
Thallium	0.25 U	0.40 UJ	--	--	0.46 BJ
Vanadium	6.0 B	3.6 B	--	--	20.1
Zinc	33.9	21.0	--	--	75.6
Cyanide	--	13.7 J	52.4 J	1.3 BJ	2.5 BJ

-- Not analyzed.

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).

R Unusable.

.030

08/20/92

TABLE 2.2 - 4

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SC01	SC02	TT0102	TT0204	TT0301	T03W01	TT0302	T03W02
	-----	-----	-----	-----	-----	-----	-----	-----
	03/07/92	03/07/92	03/06/92	03/05/92	03/10/92	03/13/92	03/10/92	03/13/92
Chloromethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Bromomethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Vinyl Chloride	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Chloroethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Methylene Chloride	12 U	76 U	1500 U	85	350	2900 U	2000 U	4500 J
Acetone	12 U	28 U	1500 U	56 U	120	2900 U	2000 U	9400 U
Carbondisulfide	12 U	5 J	1500 U	9 J	44 J	640 J	2000 U	9400 U
1,1-Dichloroethylene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,1-Dichloroethane	1 J	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,2-Dichloroethylene	4 J	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Chloroform	3 J	5 J	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,2-Dichloroethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Methyl Ethyl Ketone	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,1,1-Trichloroethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Carbon Tetrachloride	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Bromodichloromethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,2-Dichloropropane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Cis-1,3-Dichloro-1-propene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Trichloroethylene	12 U	2 J	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Chlorodibromomethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,1,2-Trichloroethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Trans-1,3-Dichloro-1-propene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Bromoform	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Methyl Isobutyl Ketone	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
2-Hexanone	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Tetrachloroethylene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
1,1,2,2-Tetrachloroethane	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Chlorobenzene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	9400 U
Styrene	12 U	15 U	1500 U	13 U	89 U	2900 U	2000 U	62000
Benzene	12 U	15 U	1500 UJ	13 U	430	18000 J	540 J	62000 J
Ethyl Benzene	12 U	15 U	310 J	13 U	330	2700 J	390 J	15000
Toluene	12 U	15 U	330 J	13 U	970	8800 J	960 J	120000 J
Xylenes	12 U	2 J	9500 J	13 U	6200	79000	6600	280000
Sum of BETX	ND	2	10000	ND	7900	110000	8500	480000

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

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08/20/92

TABLE 2.2 - 4 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	TT0303 ----- 03/11/92	TT05E01 ----- 03/10/92	TT0602 ----- 03/09/92	TT0604 ----- 03/09/92	TT0703 ----- 03/19/92	TT08A01 ----- 03/21/92	TT0802 ----- 03/21/92	TT0902 ----- 03/11/92
Chloromethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Bromomethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Vinyl Chloride	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Chloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Methylene Chloride	25 U	49 U	80 U	96 U	1400 U	24 U	66 U	16 U
Acetone	55 U	18 U	150	23 U	1400 U	28 U	63 U	49 U
Carbondisulfide	13 U	2 J	60 U	5 J	1400 U	3 J	10 J	12 U
1,1-Dichloroethylene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
1,1-Dichloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
1,2-Dichloroethylene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Chloroform	13 U	12 U	60 U	11 U	1400 U	13 U	11 J	12 U
1,2-Dichloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Methyl Ethyl Ketone	33	8 J	45 J	11 U	1400 U	13	63 U	37
1,1,1-Trichloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Carbon Tetrachloride	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Bromodichloromethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
1,2-Dichloropropane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Cis-1,3-Dichloro-1-propene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Trichloroethylene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Chlorodibromomethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
1,1,2-Trichloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Trans-1,3-Dichloro-1-propene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Bromoform	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Methyl Isobutyl Ketone	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
2-Hexanone	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Tetrachloroethylene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
1,1,2,2-Tetrachloroethane	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Chlorobenzene	13 U	12 U	60 U	11 U	1400 U	13 U	63 U	12 U
Styrene	13 U	12 U	60 U	11 U	990 J	13 U	63 U	12 U
Benzene	13 U	12 U	60 U	11 U	1400 U	3 J	18 J	12 U
Ethyl Benzene	13 U	12 U	35 J	11 U	360 J	13 U	72	12 U
Toluene	13 U	12 U	60 U	11 U	1300 J	3 J	120	1 J
Xylenes	2 J	3 J	140	11 U	12000	17	1700	2 J
Sum of BETX	2	3	180	10	14000	23	1900	3

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.030

08/20/92

TABLE 2.2 - 4 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	TT1001	TT1201	TT1301	TT1402	TT1501		TT1602	TT1701
	03/21/92	03/18/92	03/16/92	03/18/92	03/17/92	03/17/92	03/12/92	03/12/92
					SAMPLE	DUPLICATE		
Chloromethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Bromomethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Vinyl Chloride	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Chloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Methylene Chloride	2900 U	93	16 U	63 U	16 U	22 U	22 U	24 U
Acetone	2900 U	150	19 U	63 U	23 U	87 U	24 U	34 U
Carbondisulfide	2900 U	13 J	2 J	63 U	12 U	1 J	2 J	2 J
1,1-Dichloroethylene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,1-Dichloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,2-Dichloroethylene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Chloroform	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,2-Dichloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Methyl Ethyl Ketone	2900 U	64	9 J	63 U	12 U	40	15	16
1,1,1-Trichloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Carbon Tetrachloride	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Bromodichloromethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,2-Dichloropropane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Cis-1,3-Dichloro-1-propene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Trichloroethylene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Chlorodibromomethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,1,2-Trichloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Trans-1,3-Dichloro-1-propene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Bromoform	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Methyl Isobutyl Ketone	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
2-Hexanone	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Tetrachloroethylene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
1,1,2,2-Tetrachloroethane	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Chlorobenzene	2900 U	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Styrene	3700	60 U	11 U	63 U	12 U	12 U	11 U	11 U
Benzene	31000	600	11 U	1000 J	12 U	1 J	11 U	11 U
Ethyl Benzene	4900	8800	2 J	3100	12 U	12 U	11 U	11 U
Toluene	58000	280	1 J	35 J	12 U	2 J	11 U	11 U
Xylenes	90000	89000	9 J	8000	12 U	6 J	11 U	11 U
Sum of BETX	180000	99000	12	12000	ND	9	ND	ND

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.030

08/20/92

TABLE 2.2 - 4 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	TT1901	TT2101	TT2201		TT2303
	-----	-----	-----	-----	-----
	03/17/92	03/16/92	03/12/92 SAMPLE	03/12/92 DUPLICATE	03/19/92
Chloromethane	64 U	12 U	14 U	14 U	2900 U
Bromomethane	64 U	12 U	14 U	14 U	2900 U
Vinyl Chloride	64 U	12 U	14 U	14 U	2900 U
Chloroethane	64 U	12 U	14 U	14 U	2900 U
Methylene Chloride	71 U	12 U	42	83	2900 U
Acetone	130	12 U	42 U	98	2900 U
Carbondisulfide	9 J	12 U	6 J	10 J	480 J
1,1-Dichloroethylene	64 U	12 U	14 U	14 U	2900 U
1,1-Dichloroethane	64 U	12 U	14 U	14 U	2900 U
1,2-Dichloroethylene	64 U	12 U	14 U	14 U	2900 U
Chloroform	13 J	12 U	14 U	14 U	2900 U
1,2-Dichloroethane	64 U	12 U	14 U	14 U	2900 U
Methyl Ethyl Ketone	61 J	12 U	21	42	2900 U
1,1,1-Trichloroethane	64 U	12 U	14 U	6 J	2900 U
Carbon Tetrachloride	64 U	12 U	14 U	14 U	2900 U
Bromodichloromethane	64 U	12 U	14 U	14 U	2900 U
1,2-Dichloropropane	64 U	12 U	14 U	14 U	2900 U
Cis-1,3-Dichloro-1-propene	64 U	12 U	14 U	14 U	2900 U
Trichloroethylene	64 U	12 U	14 U	14 U	2900 U
Chlorodibromomethane	64 U	12 U	14 U	14 U	2900 U
1,1,2-Trichloroethane	64 U	12 U	14 U	14 U	2900 U
Trans-1,3-Dichloro-1-propene	64 U	12 U	14 U	14 U	2900 U
Bromoform	64 U	12 U	14 U	14 U	2900 U
Methyl Isobutyl Ketone	64 U	12 U	14 U	14 U	2900 U
2-Hexanone	64 U	12 U	14 U	14 U	2900 U
Tetrachloroethylene	64 U	12 U	14 U	14 U	2900 U
1,1,2,2-Tetrachloroethane	64 U	12 U	14 U	14 U	2900 U
Chlorobenzene	64 U	12 U	14 U	14 U	2900 U
Styrene	64 U	12 U	14 U	14 U	2900 U
Benzene	750	12 U	14 U	14 U	22000
Ethyl Benzene	610 J	12 U	14 U	14 U	64000
Toluene	64 J	12 U	14 U	14 U	140000
Xylenes	1400 J	12 U	14 U	14 U	370000
Sum of BETX	2800	ND	ND	ND	600000

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.030

08/20/92

TABLE 2.2 - 5

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	SC01 ----- 03/07/92	SC02 ----- 03/07/92	T03W02 ----- 03/13/92	TT0602 ----- 03/09/92	TT0604 ----- 03/09/92	TT1402 ----- 03/18/92
Naphthalene	410 U	400 J	2000000	38000 U	330 J	34000
2-Methylnaphthalene	410 U	150 J	330000	38000 U	160 J	5300
Acenaphthylene	410 U	210 J	300000	38000 U	180 J	560 J
Acenaphthene	410 U	47 J	40000 J	180000	56 J	3500
Dibenzofuran	410 U	240 J	170000	150000	160 J	2900
Fluorene	410 U	550	280000	170000	300 J	3700
Phenanthrene	410 U	1900	460000	280000	1000	5400
Anthracene	410 U	420 J	200000	38000	300 J	1700
Fluoranthene	43 J	1900	300000	99000	1200	4400
Pyrene	410 U	1300	240000	61000	940	3200
Benzo(ghi)perylene	410 U	220 J	24000 J	38000 U	240 J	1600 U
Benzo(a)anthracene	410 U	930	150000	14000 J	650	1200 J
Benzo(b)fluoranthene	410 U	650	73000 J	38000 U	750	830 J
Benzo(k)fluoranthene	410 U	670	90000 J	3900 J	440	940 J
Benzo(a)pyrene	410 U	590	90000 J	38000 U	500	870 J
Chrysene	410 U	1200	120000	11000 J	1100	1200 J
Dibenzo(ah)anthracene	410 U	110 J	12000 J	38000 U	190 J	1600 U
Indeno(1,2,3,cd)pyrene	410 U	330 J	35000 J	38000 U	320 J	510 J
Sum of Carcinogenic PAHs	ND	4500	570000	29000	4000	5600
Sum of PAHs	43	12000	5000000	1000000	8900	70000
PHENOLIC COMPOUNDS						
Phenol	410 U	440 U	41000 J	38000 U	370 U	1600 U
2-Chlorophenol	410 U	440 U	97000 U	38000 U	370 U	1600 U
o-Cresol	410 U	440 U	29000 J	38000 U	370 U	1600 U
p-Cresol	410 U	440 U	71000 J	38000 U	370 U	1600 U
2-Nitrophenol	410 U	440 U	97000 U	38000 U	370 U	1600 U
2,4-Dimethylphenol	410 U	440 U	32000 J	38000 U	370 U	1600 U
4-Chloro-3-methylphenol	410 U	440 U	97000 U	38000 U	370 U	1600 U
2,4,6-Trichlorophenol	410 U	440 U	97000 U	38000 U	370 U	1600 U
2,4,5-Trichlorophenol	990 U	1100 U	240000 U	92000 U	890 U	4000 U
2,4-Dinitrophenol	990 U	1100 U	240000 U	92000 U	890 U	4000 U
4-Nitrophenol	990 U	1100 U	240000 U	92000 U	890 U	4000 U
2-Methyl-4,6-dinitrophenol	990 U	1100 U	240000 U	92000 U	890 U	4000 U
Pentachlorophenol	990 U	1100 U	240000 U	92000 U	890 U	4000 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.011

08/20/92

TABLE 2.2 - 5 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SC01	SC02	T03W02	TT0602	TT0604	TT1402
	-----	-----	-----	-----	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	03/07/92	03/07/92	03/13/92	03/09/92	03/09/92	03/18/92
Bis(2-chloroethyl)ether	410 U	440 U	97000 U	38000 U	370 U	1600 U
1,3-Dichlorobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
1,4-Dichlorobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
1,2-Dichlorobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
Bis(2-chloroisopropyl)ether	410 U	440 U	97000 U	38000 U	370 U	1600 U
N-Nitrosodi-n-propylamine	410 U	440 U	97000 U	38000 U	370 U	1600 U
Hexachloroethane	410 U	440 U	97000 U	38000 U	370 U	1600 U
Nitrobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
Isophorone	410 U	440 U	97000 U	38000 U	370 U	1600 U
Bis(2-chloroethoxy)methane	410 U	440 U	97000 U	38000 U	370 U	1600 U
1,2,4-Trichlorobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
4-Chloroaniline	410 U	440 U	97000 U	38000 U	370 U	1600 U
Hexachlorobutadiene	410 U	440 U	97000 U	38000 U	370 U	1600 U
Hexachlorocyclopentadiene	410 U	440 U	97000 U	38000 U	370 U	1600 U
2-Chloronaphthalene	410 U	440 U	97000 U	38000 U	370 U	1600 U
2-Nitroaniline	990 U	1100 U	240000 U	92000 U	890 U	4000 U
Dimethyl phthalate	410 U	440 U	97000 U	38000 U	370 U	1600 U
2,6-Dinitrotoluene	410 U	440 U	97000 U	38000 U	370 U	1600 U
3-Nitroaniline	990 U	1100 U	240000 U	92000 U	890 U	4000 U
2,4-Dinitrotoluene	410 U	440 U	97000 U	38000 U	370 U	1600 U
Diethyl phthalate	410 U	440 U	97000 U	38000 U	370 U	1600 U
4-Chlorophenyl phenyl ether	410 U	440 U	97000 U	38000 U	370 U	1600 U
4-Nitroaniline	990 U	1100 U	240000 U	92000 U	890 U	4000 U
N-Nitrosodiphenylamine	410 U	440 U	97000 U	38000 U	370 U	1600 U
4-Bromophenyl phenyl ether	410 U	440 U	97000 U	38000 U	370 U	1600 U
Hexachlorobenzene	410 U	440 U	97000 U	38000 U	370 U	1600 U
Di-n-butyl phthalate	410 U	440 U	97000 U	38000 U	370 U	1600 U
Butyl benzyl phthalate	410 U	440 U	97000 U	38000 U	370 U	1600 U
3,3-Dichlorobenzidine	410 U	440 U	97000 U	38000 U	370 U	1600 U
Bis(2-ethylhexyl)phthalate	51 J	440 U	97000 U	38000 U	43 J	1600 U
Di-n-octyl phthalate	410 U	440 U	97000 U	38000 U	370 U	1600 U
Carbazole	410 U	270 J	99000	38000 U	140 J	850 J
2,4-Dichlorophenol	410 U	440 U	97000 U	38000 U	370 U	1600 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.011

08/20/92

TABLE 2.2 - 6

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	TT0102		TT0206	TT0209	TT0301	TT0301	TT0302	TT0303
	03/06/92 SAMPLE	03/06/92 DUPLICATE	03/05/92	03/05/92	03/10/92	03/13/92	03/10/92	03/11/92
Naphthalene	1900000	660000	5100	360 U	710000	3500000	170000	390 U
2-Methylnaphthalene	300000	120000	1300 J	360 U	100000 J	340000 J	33000	390 U
Acenaphthylene	47000 J	25000 J	1900	240 J	26000 J	63000 J	18000 J	43 J
Acenaphthene	11000 J	4700 J	290 J	360 U	100000 U	490000 U	26000 U	390 U
Dibenzofuran	58000 J	27000 J	1200 J	360 U	19000 J	76000 J	32000	390 U
Fluorene	96000	42000	1700	360 U	32000 J	120000 J	26000 U	390 U
Phenanthrene	120000	60000	9500	270 J	54000 J	160000 J	140000	390 U
Anthracene	32000 J	16000 J	2900	150 J	14000 J	490000 U	33000	390 U
Fluoranthene	57000 J	32000	10000	1600	23000 J	490000 U	120000	390 U
Pyrene	39000 J	22000 J	8800	1400	15000 J	490000 U	93000	390 U
Benzo(ghi)perylene	80000 U	4000 J	4200	450	100000 U	490000 U	15000 J	390 U
Benzo(a)anthracene	26000 J	12000 J	9000	1400	100000 U	490000 U	56000	390 U
Benzo(b)fluoranthene	18000 J	9900 J	13000	1500	100000 U	490000 U	38000	390 U
Benzo(k)fluoranthene	19000 J	11000 J	5100	830	100000 U	490000 U	33000	390 U
Benzo(a)pyrene	18000 J	10000 J	8200	1200	100000 U	490000 U	35000	390 U
Chrysene	29000 J	15000 J	10000	1300	100000 U	490000 U	56000	390 U
Dibenzo(ah)anthracene	80000 U	31000 U	4800	340 J	100000 U	490000 U	26000 U	390 U
Indeno(1,2,3,cd)pyrene	9500 J	5600 J	6900	740	100000 U	490000 U	22000 J	390 U
Sum of Carcinogenic PAHs	120000	64000	57000	7300	ND	ND	240000	ND
Sum of PAHs	2800000	1100000	100000	11000	1000000	4300000	880000	43
PHENOLIC COMPOUNDS								
Phenol	80000 U	31000 U	290 J	360 U	--	490000 U	26000	--
2-Chlorophenol	80000 U	31000 U	1300 U	360 U	--	490000 U	26000 U	--
o-Cresol	80000 U	31000 U	160 J	360 U	--	490000 U	9300 J	--
p-Cresol	80000 U	31000 U	370 J	360 U	--	490000 U	24000 J	--
2-Nitrophenol	80000 U	31000 U	1300 U	360 U	--	490000 U	26000 U	--
2,4-Dimethylphenol	80000 U	31000 U	180 J	360 U	--	490000 U	5500 J	--
4-Chloro-3-methylphenol	80000 U	31000 U	1300 U	360 U	--	490000 U	26000 U	--
2,4,6-Trichlorophenol	80000 U	31000 U	1300 U	360 U	--	490000 U	26000 U	--
2,4,5-Trichlorophenol	190000 U	75000 U	3200 U	880 U	--	1200000 U	62000 U	--
2,4-Dinitrophenol	190000 U	75000 U	3200 U	880 U	--	1200000 U	62000 U	--
4-Nitrophenol	190000 U	75000 U	310 J	880 U	--	1200000 U	62000 U	--
2-Methyl-4,6-dinitrophenol	190000 U	75000 U	3200 U	880 U	--	1200000 U	62000 U	--
Pentachlorophenol	190000 U	75000 U	3200 U	880 U	--	1200000 U	62000 U	--

ND None detected.

-- Not analyzed.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.015

08/20/92

TABLE 2.2 - 6 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

	TT0403	TT05E01	TT0703	TT0802	TT0902	TT1001		TT1201
	-----	-----	-----	-----	-----	-----		-----
PROJECT SPECIFIC	03/05/92	03/10/92	03/19/92	03/21/92	03/11/92	03/21/92	03/21/92	03/18/92
PAH COMPOUNDS						SAMPLE	DUPLICATE	
Naphthalene	410 U	400 U	1600000	410000	390 U	610000	720000	640000
2-Methylnaphthalene	220 J	400 U	200000 J	61000	390 U	120000 J	110000 J	120000 J
Acenaphthylene	160 J	310 J	68000 J	16000 J	390 U	65000 J	31000 J	130000 J
Acenaphthene	410 U	400 U	210000 U	60000 U	390 U	120000 U	140000 U	53000 J
Dibenzofuran	74 J	400 U	210000 U	14000 J	390 U	17000 J	16000 J	28000 J
Fluorene	100 J	43 J	58000 J	23000 J	390 U	27000 J	25000 J	52000 J
Phenanthrene	1000	550	83000 J	29000 J	42 J	23000 J	16000 J	50000 J
Anthracene	270 J	310 J	24000 J	7000 J	390 U	120000 U	140000 U	13000 J
Fluoranthene	1100	3200	36000 J	14000 J	120 J	120000 U	140000 U	22000 J
Pyrene	920	2800	24000 J	9900 J	87 J	120000 U	140000 U	14000 J
Benzo(ghi)perylene	310 J	450	210000 U	60000 U	390 U	120000 U	140000 U	130000 U
Benzo(a)anthracene	750	1200	210000 U	6600 J	390 U	120000 U	140000 U	130000 U
Benzo(b)fluoranthene	830	1900	210000 U	60000 U	42 J	120000 U	140000 U	130000 U
Benzo(k)fluoranthene	660	1000	210000 U	60000 U	390 U	120000 U	140000 U	130000 U
Benzo(a)pyrene	560	1100	210000 U	60000 U	390 U	120000 U	140000 U	130000 U
Chrysene	1200	2200	22000 J	7100 J	47 J	120000 U	140000 U	130000 U
Dibenzo(ah)anthracene	250 J	260 J	210000 U	60000 U	390 U	120000 U	140000 U	130000 U
Indeno(1,2,3,cd)pyrene	380 J	750	210000 U	60000 U	390 U	120000 U	140000 U	130000 U
Sum of Carcinogenic PAHs	4600	8400	22000	14000	89	ND	ND	ND
Sum of PAHs	8800	16000	2100000	600000	340	860000	920000	990000
PHENOLIC COMPOUNDS								
Phenol	410 U	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
2-Chlorophenol	410 U	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
o-Cresol	120 J	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
p-Cresol	280 J	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
2-Nitrophenol	410 U	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
2,4-Dimethylphenol	100 J	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
4-Chloro-3-methylphenol	410 U	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
2,4,6-Trichlorophenol	410 U	--	210000 U	60000 U	--	120000 U	140000 U	130000 U
2,4,5-Trichlorophenol	1000 U	--	510000 U	150000 U	--	300000 U	340000 U	300000 U
2,4-Dinitrophenol	1000 U	--	510000 U	150000 U	--	300000 U	340000 U	300000 U
4-Nitrophenol	1000 U	--	510000 U	150000 U	--	300000 U	340000 U	300000 U
2-Methyl-4,6-dinitrophenol	1000 U	--	510000 U	150000 U	--	300000 U	340000 U	300000 U
Pentachlorophenol	1000 U	--	510000 U	150000 U	--	300000 U	340000 U	300000 U

ND None detected.

-- Not analyzed.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.015

08/20/92

TABLE 2.2 - 6 (cont.)

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	TT1301 ----- 03/16/92	TT1501 ----- 03/17/92	TT1602 ----- 03/12/92	TT1701 ----- 03/12/92	TT1901 ----- 03/17/92	TT2101 ----- 03/16/92
Naphthalene	350 U	1100	44 J	400 U	68000	420 U
2-Methylnaphthalene	350 U	60 J	370 U	400 U	11000	55 J
Acenaphthylene	350 U	500	51 J	400 U	3900 J	180 J
Acenaphthene	350 U	140 J	370 U	400 U	27000	420 U
Dibenzofuran	350 U	270 J	370 U	400 U	16000	100 J
Fluorene	350 U	430	370 U	400 U	46000	330 J
Phenanthrene	350 U	420	42 J	400 U	130000	1300
Anthracene	350 U	38 J	88 J	400 U	32000	1000
Fluoranthene	350 U	125 J	580	42 J	81000	1900
Pyrene	350 U	120 J	460	400 U	55000	1300
Benzo(ghi)perylene	350 U	370 U	47 J	400 U	3700 J	230 J
Benzo(a)anthracene	350 U	370 U	160 J	400 U	24000	1200
Benzo(b)fluoranthene	350 U	40 J	140 J	400 U	17000	970
Benzo(k)fluoranthene	350 U	370 U	100 J	400 U	12000	530
Benzo(a)pyrene	350 U	370 U	110 J	400 U	13000	660
Chrysene	350 U	370 U	190 J	400 U	26000	1700
Dibenzo(ah)anthracene	350 U	370 U	370 U	400 U	8400 U	420 U
Indeno(1,2,3,cd)pyrene	350 U	370 U	79 J	400 U	7700 J	440
Sum of Carcinogenic PAHs	ND	40	780	ND	100000	5500
Sum of PAHs	ND	3200	2100	42	570000	12000

PHENOLIC COMPOUNDS

Phenol	--	--	--	400 U	--	--
2-Chlorophenol	--	--	--	400 U	--	--
o-Cresol	--	--	--	400 U	--	--
p-Cresol	--	--	--	400 U	--	--
2-Nitrophenol	--	--	--	400 U	--	--
2,4-Dimethylphenol	--	--	--	400 U	--	--
4-Chloro-3-methylphenol	--	--	--	400 U	--	--
2,4,6-Trichlorophenol	--	--	--	400 U	--	--
2,4,5-Trichlorophenol	--	--	--	980 U	--	--
2,4-Dinitrophenol	--	--	--	980 U	--	--
4-Nitrophenol	--	--	--	980 U	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	980 U	--	--
Pentachlorophenol	--	--	--	980 U	--	--

ND None detected.

-- Not analyzed.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.015

08/20/92

TABLE 2.2 - 7

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
PESTICIDES AND PCBs

(concentrations in ug/kg)

	SC01	SC02	T03W02	TT0602	TT0604	TT1402
	-----	-----	-----	-----	-----	-----
	03/07/92	03/07/92	03/13/92	03/09/92	03/09/92	03/18/92
a-BHC	2.1 U	12 U	200 U	39 U	19 U	8.4 U
b-BHC	2.1 U	12 U	200 U	39 U	19 U	8.4 U
d-BHC	2.1 U	12 U	200 U	39 U	19 U	8.4 U
g-BHC (Lindane)	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Heptachlor	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Aldrin	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Heptachlor Epoxide	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Endosulfan I	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Dieldrin	4.1 U	22 U	390 U	75 U	38 U	16 U
4,4'-DDE	4.1 U	22 U	390 U	75 U	38 U	16 U
Endrin	4.1 U	22 U	390 U	75 U	38 U	16 U
Endosulfan II	4.1 U	22 U	390 U	75 U	38 U	16 U
4,4'-DDD	4.1 U	22 U	390 U	75 U	38 U	16 U
Endosulfan Sulfate	4.1 U	22 U	390 U	75 U	38 U	16 U
4,4'-DDT	4.1 U	22 U	390 U	75 U	38 U	16 U
Methoxychlor	21 U	120 U	2000 UJ	390 U	38 U	84 U
Endrin Ketone	4.1 U	22 U	390 U	75 U	38 U	16 U
Endrin Aldehyde	4.1 U	22 U	390 U	75 U	38 U	16 U
cis-Chlordane	2.1 U	12 U	200 U	39 U	19 U	8.4 U
trans-Chlordane	2.1 U	12 U	200 U	39 U	19 U	8.4 U
Toxaphene	210 U	1200 U	100000 U	3900 U	1900 U	4200 U
PCB-1016	41 U	220 U	20000 U	750 U	380 U	800 U
PCB-1221	83 U	440 U	40000 U	1600 U	750 U	1600 U
PCB-1232	41 U	220 U	20000 U	750 U	380 U	800 U
PCB-1242	41 U	220 U	20000 U	750 U	380 U	800 U
PCB-1248	41 U	220 U	20000 U	750 U	380 U	800 U
PCB-1254	41 U	220 U	20000 U	750 U	380 U	800 U
PCB-1260	41 U	220 U	20000 U	750 U	380 U	800 U

U Not detected.

J Associated value is an estimate.

.007

08/20/92

TABLE 2.2 - 8

SOIL QUALITY DATA
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES
TCLP ANALYSIS

(concentrations in ug/L)

TT0604		
	03/09/92	03/09/92
	SAMPLE	DUPLICATE
Vinyl Chloride, TCLP	50 U	50 U
1,1-Dichloroethene, TCLP	25 U	25 U
Chloroform, TCLP	25 U	25 U
1,2-Dichloroethane, TCLP	25 U	25 U
2-Butanone, TCLP	50 U	50 U
Carbon Tetrachloride, TCLP	25 U	25 U
Trichloroethene, TCLP	25 U	25 U
Benzene, TCLP	25 U	25 U
Tetrachloroethene, TCLP	25 U	25 U
Chlorobenzene, TCLP	25 U	25 U
1,4-Dichlorobenzene, TCLP	50 U	50 U
o-Cresol, TCLP	50 U	50 U
m-Cresol, TCLP	50 U	50 U
p-Cresol, TCLP	50 U	50 U
Hexachloroethane, TCLP	50 U	50 U
Nitrobenzene, TCLP	50 U	50 U
Hexachlorobutadiene, TCLP	50 U	50 U
2,4,6-Trichlorophenol, TCLP	50 U	50 U
2,4,5-Trichlorophenol, TCLP	250 U	250 U
2,4-Dinitrotoluene, TCLP	50 U	50 U
Hexachlorobenzene, TCLP	50 U	50 U
Pentachlorophenol, TCLP	250 U	250 U
Pyridine, TCLP	250 U	250 U
g-BHC (Lindane), TCLP	2 U	2 U
Heptachlor, TCLP	2 U	2 U
Heptachlor Epoxide, TCLP	2 U	2 U
Endrin, TCLP	2 U	2 U
Methoxychlor, TCLP	10 U	10 U
Chlordane, TCLP	10 U	10 U
Toxaphene, TCLP	50 U	50 U
2,4-D, TCLP	100 U	100 U
2,4,5-TP (Silvex), TCLP	10 U	10 U
Silver, TCLP	10.0 U	10.0 U
Arsenic, TCLP	30.0 U	30.0 U
Barium, TCLP	832	876
Cadmium, TCLP	5.0 U	6.3
Chromium, TCLP	10.0 U	10.0 U
Mercury, TCLP	0.2 U	0.2 U
Lead, TCLP	30.0 U	30.0 U
Selenium, TCLP	60.0 U	60.0 U

U Not detected.

.031

08/20/92

TABLE 2.2 - 9

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
INORGANICS

(concentrations in mg/kg)

	BS01	BS02	BS03	BS04	BS05
	-----	-----	-----	-----	-----
	03/05/92	03/05/92	03/05/92	03/05/92	03/05/92
Aluminum	1520 J	1930 J	4560 J	1840 J	1180 J
Antimony	2.3 UJ	2.3 UJ	5.8 BJ	2.3 UJ	2.7 UJ
Arsenic	1.7 B	2.0 B	235	1.9 B	0.76 UJ
Barium	6.4 BJ	11.2 BJ	232 J	22.2 BJ	5.1 BJ
Beryllium	0.12 UJ	0.14 UJ	0.40 BJ	0.17 UJ	0.14 UJ
Cadmium	0.62 U	0.62 U	7.3	0.61 U	0.72 U
Calcium	28500	31900	36100	16200	21800
Chromium, total	5.3 U	5.9 U	231	18.1	5.1 U
Cobalt	2.4 B	2.3 B	7.3 B	1.8 B	2.4 B
Copper	5.2 B	7.1	160	4.3 B	3.9 B
Iron	3710	4330	39700	4110	3910
Lead	3.6 J	9.2 J	434 J	5.0 J	3.4 J
Magnesium	13800	16200	17300	7670	12700
Manganese	123	163	357	78.6	121
Mercury	0.08 U	0.08 U	1.7	0.08 U	0.09 U
Nickel	3.2 B	4.8 B	33.3	3.7 B	3.6 B
Potassium	311 B	403 B	680 B	278 B	296 B
Selenium	0.27 U	0.27 U	0.93 BJ	0.27 U	0.32 U
Silver	0.71 B	0.36 U	5.4	0.36 U	0.74 B
Sodium	285 U	312 U	447 U	339 U	314 U
Thallium	0.23 U	0.23 U	0.31 U	0.23 U	0.34 B
Vanadium	6.9 B	8.0 B	14.3	5.6 B	10.7 B
Zinc	19.2	27.6	764	20.4	17.6
Cyanide	0.19 U	0.19 U	0.25 U	0.19 U	0.22 U
	BS06		BS07	BS08	
	-----	-----	-----	-----	
	03/25/92	03/25/92	03/25/92	03/25/92	
		DUPLICATE			
Aluminum	1670	3550	881	896	
Antimony	2.9 BJ	2.3 UJ	3.4 BJ	2.6 UJ	
Arsenic	1.7 BJ	1.7 BJ	2.2 BJ	2.8 J	
Barium	8.8 BJ	12.2 BJ	5.5 BJ	6.6 BJ	
Beryllium	0.20 UJ	0.29 BJ	0.23 UJ	0.16 UJ	
Cadmium	0.62 U	0.62 U	0.70 U	0.71 U	
Calcium	27800	27300	23100	24800	
Chromium, total	5.3	8.5	14.6	5.7	
Cobalt	2.9 B	5.8 B	1.6 B	2.2 B	
Copper	8.3	24.3	7.5	6.5	
Iron	5380	10100	2560	2820	
Lead	3.5 J	3.1 J	3.6 J	4.8 J	
Magnesium	14600	16000	11800	12900	
Manganese	194	249	103	133	
Mercury	0.07 UJ	0.08 UJ	0.08 UJ	0.08 UJ	
Nickel	5.3 B	12.8	3.9 B	2.6 B	
Potassium	151 U	365 B	169 U	172 U	
Selenium	0.27 U	0.27 U	0.31 U	0.31 U	
Silver	0.37 U	0.37 U	0.41 U	0.42 U	
Sodium	204 UJ	326 UJ	229 UJ	288 UJ	
Thallium	0.35 U	0.35 U	0.30 B	0.40 U	
Vanadium	14.9	32.9	4.4 B	4.9 B	
Zinc	21.2 J	40.8 J	28.8 J	30.8 J	
Cyanide	0.79 BJ	1.2 BJ	0.22 R	0.22 R	

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).

R Unusable.

.009

07/21/92

TABLE 2.2 - 10

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	BS01	BS02	BS03	BS04	BS05
	-----	-----	-----	-----	-----
	03/05/92	03/05/92	03/05/92	03/05/92	03/05/92
Chloromethane	11 U	11 U	13 U	11 U	12 U
Bromomethane	11 U	11 U	13 U	11 U	12 U
Vinyl Chloride	11 U	11 U	13 U	11 U	12 U
Chloroethane	11 U	11 U	13 U	11 U	12 U
Methylene Chloride	32 U	23 U	51 U	19 U	26 U
Acetone	14 U	23 U	39 U	11 U	12 U
Carbondisulfide	2 J	3 J	4 J	11 U	12 U
1,1-Dichloroethylene	11 U	11 U	13 U	11 U	12 U
1,1-Dichloroethane	11 U	11 U	13 U	11 U	12 U
1,2-Dichloroethylene	11 U	11 U	13 U	11 U	12 U
Chloroform	11 U	11 U	11 U	11 U	12 U
1,2-Dichloroethane	11 U	11 U	13 U	11 U	12 U
Methyl Ethyl Ketone	11 U	11 U	13 U	11 U	12 U
1,1,1-Trichloroethane	11 U	11 U	13 U	11 U	12 U
Carbon Tetrachloride	11 U	11 U	13 U	11 U	12 U
Bromodichloromethane	11 U	11 U	13 U	11 U	12 U
1,2-Dichloropropane	11 U	11 U	13 U	11 U	12 U
Cis-1,3-Dichloro-1-propene	11 U	11 U	13 U	11 U	12 U
Trichloroethylene	11 U	11 U	2 J	11 U	12 U
Chlorodibromomethane	11 U	11 U	13 U	11 U	12 U
1,1,2-Trichloroethane	11 U	11 U	13 U	11 U	12 U
Trans-1,3-Dichloro-1-propene	11 U	11 U	13 U	11 U	12 U
Bromoform	11 U	11 U	13 U	11 U	12 U
Methyl Isobutyl Ketone	11 U	11 U	13 U	11 U	12 U
2-Hexanone	11 U	11 U	13 U	11 U	12 U
Tetrachloroethylene	11 U	11 U	13 U	11 U	12 U
1,1,2,2-Tetrachloroethane	11 U	11 U	13 U	11 U	12 U
Chlorobenzene	11 U	11 U	13 U	11 U	12 U
Styrene	11 U	11 U	13 U	11 U	12 U
Benzene	11 U	11 U	13 U	11 U	12 U
Ethyl Benzene	11 U	11 U	13 U	11 U	12 U
Toluene	11 U	11 U	2 J	11 U	12 U
Xylenes	11 U	4 J	7 J	11 U	12 U
Sum of BETX	ND	4	9	ND	ND

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.017

08/20/92

TABLE 2.2 - 10 (cont.)

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	BS06		BS07	BS08
	03/25/92	03/25/92 DUPLICATE	03/25/92	03/25/92
Chloromethane	11 U	11 U	12 U	12 U
Bromomethane	11 U	11 U	12 U	12 U
Vinyl Chloride	11 U	11 U	12 U	12 U
Chloroethane	11 U	11 U	12 U	12 U
Methylene Chloride	11 U	11 U	26 U	26 U
Acetone	11 U	11 U	51 U	25 U
Carbondisulfide	11 U	11 U	12 U	12 U
1,1-Dichloroethylene	11 U	11 U	12 U	12 U
1,1-Dichloroethane	11 U	11 U	12 U	12 U
1,2-Dichloroethylene	11 U	11 U	12 U	12 U
Chloroform	11 U	11 U	12 U	12 U
1,2-Dichloroethane	11 U	11 U	12 U	12 U
Methyl Ethyl Ketone	11 U	11 U	20	12
1,1,1-Trichloroethane	11 U	11 U	12 U	12 U
Carbon Tetrachloride	11 U	11 U	12 U	12 U
Bromodichloromethane	11 U	11 U	12 U	12 U
1,2-Dichloropropene	11 U	11 U	12 U	12 U
Cis-1,3-Dichloro-1-propene	11 U	11 U	12 U	12 U
Trichloroethylene	11 U	11 U	12 U	12 U
Chlorodibromomethane	11 U	11 U	12 U	12 U
1,1,2-Trichloroethane	11 U	11 U	12 U	12 U
Trans-1,3-Dichloro-1-propene	11 U	11 U	12 U	12 U
Bromoform	11 U	11 U	12 U	12 U
Methyl Isobutyl Ketone	11 U	11 U	12 U	12 U
2-Hexanone	11 U	11 U	12 U	12 U
Tetrachloroethylene	11 U	11 U	12 U	12 U
1,1,2,2-Tetrachloroethane	11 U	11 U	12 U	12 U
Chlorobenzene	11 U	11 U	12 U	12 U
Styrene	11 U	11 U	12 U	12 U
Benzene	2 J	11 U	12 U	12 U
Ethyl Benzene	11 U	11 U	12 U	12 U
Toluene	3 J	11 U	12 U	12 U
Xylenes	4 J	1 J	2 J	1 J
Sum of BETX	9	1	2	1

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.017

08/20/92

TABLE 2.2 - 11

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	BS01 ----- 03/05/92	BS02 ----- 03/05/92	BS03 ----- 03/05/92	BS04 ----- 03/05/92	BS05 ----- 03/05/92
Naphthalene	350 U	350 U	120 J	350 U	390 U
2-Methylnaphthalene	350 U	350 U	87 J	350 U	390 U
Acenaphthylene	350 U	350 U	590	350 U	390 U
Acenaphthene	350 U	350 U	160 J	350 U	390 U
Dibenzofuran	350 U	350 U	89 J	350 U	390 U
Fluorene	350 U	350 U	260 J	350 U	390 U
Phenanthrene	350 U	68 J	1300	350 U	170 J
Anthracene	350 U	350 U	560	350 U	390 U
Fluoranthene	47 J	90 J	2400	350 U	180 J
Pyrene	35 J	77 J	2600	350 U	100 J
Benzo(ghi)perylene	350 U	350 U	810	350 U	390 U
Benzo(a)anthracene	350 U	40 J	1600	350 U	63 J
Benzo(b)fluoranthene	350 U	42 J	2000	350 U	63 J
Benzo(k)fluoranthene	350 U	46 J	1100	350 U	90 J
Benzo(a)pyrene	350 U	350 U	1400	350 U	46 J
Chrysene	40 J	54 J	1700	350 U	63 J
Dibenzo(ah)anthracene	350 U	350 U	440 J	350 U	390 U
Indeno(1,2,3,cd)pyrene	350 U	350 U	1100	350 U	40 J
Sum of Carcinogenic PAHs	40	180	9300	ND	370
Sum of PAHs	120	420	18000	ND	820
PHENOLIC COMPOUNDS					
Phenol	350 U	350 U	450 U	350 U	390 U
2-Chlorophenol	350 U	350 U	450 U	350 U	390 U
o-Cresol	350 U	350 U	450 U	350 U	390 U
p-Cresol	350 U	350 U	450 U	350 U	390 U
2-Nitrophenol	350 U	350 U	450 U	350 U	390 U
2,4-Dimethylphenol	350 U	350 U	450 U	350 U	390 U
4-Chloro-3-methylphenol	350 U	350 U	450 U	350 U	390 U
2,4,6-Trichlorophenol	350 U	350 U	450 U	350 U	390 U
2,4,5-Trichlorophenol	840 U	840 U	1100 U	840 U	950 U
2,4-Dinitrophenol	840 U	850 U	1100 U	840 U	950 U
4-Nitrophenol	840 U	850 U	1100 U	840 U	950 U
2-Methyl-4,6-dinitrophenol	840 U	850 U	1100 U	840 U	950 U
Pentachlorophenol	840 U	850 U	1100 U	840 U	950 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.011

08/20/92

TABLE 2.2 - 11 (cont.)

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	BS01	BS02	BS03	BS04	BS05
	-----	-----	-----	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	03/05/92	03/05/92	03/05/92	03/05/92	03/05/92
Bis(2-chloroethyl)ether	350 U	350 U	450 U	350 U	390 U
1,3-Dichlorobenzene	350 U	350 U	450 U	350 U	390 U
1,4-Dichlorobenzene	350 U	350 U	450 U	350 U	390 U
1,2-Dichlorobenzene	350 U	350 U	450 U	350 U	390 U
Bis(2-chloroisopropyl)ether	350 U	350 U	450 U	350 U	390 U
N-Nitrosodi-n-propylamine	350 U	350 U	450 U	350 U	390 U
Hexachloroethane	350 U	350 U	450 U	350 U	390 U
Nitrobenzene	350 U	350 U	450 U	350 U	390 U
Isophorone	350 U	350 U	450 U	350 U	390 U
Bis(2-chloroethoxy)methane	350 U	350 U	450 U	350 U	390 U
1,2,4-Trichlorobenzene	350 U	350 U	450 U	350 U	390 U
4-Chloroaniline	350 U	350 U	450 U	350 U	390 U
Hexachlorobutadiene	350 U	350 U	450 U	350 U	390 U
Hexachlorocyclopentadiene	350 U	350 U	450 U	350 U	390 U
2-Chloronaphthalene	350 U	350 U	450 U	350 U	390 U
2-Nitroaniline	840 U	850 U	1100 U	840 U	950 U
Dimethyl phthalate	350 U	350 U	450 U	350 U	390 U
2,6-Dinitrotoluene	350 U	350 U	450 U	350 U	390 U
3-Nitroaniline	840 U	850 U	1100 U	840 U	950 U
2,4-Dinitrotoluene	350 U	350 U	450 U	350 U	390 U
Diethyl phthalate	350 U	350 U	450 U	350 U	390 U
4-Chlorophenyl phenyl ether	350 U	350 U	450 U	350 U	390 U
4-Nitroaniline	840 U	850 U	1100 U	840 U	950 U
N-Nitrosodiphenylamine	350 U	350 U	450 U	350 U	390 U
4-Bromophenyl phenyl ether	350 U	350 U	450 U	350 U	390 U
Hexachlorobenzene	350 U	350 U	450 U	350 U	390 U
Di-n-butyl phthalate	350 U	350 U	450 U	350 U	390 U
Butyl benzyl phthalate	350 U	350 U	450 U	350 U	390 U
3,3-Dichlorobenzidine	350 U	350 U	450 U	350 U	390 U
Bis(2-ethylhexyl)phthalate	420 U	350 U	4500	350 U	390 U
Di-n-octyl phthalate	350 U	350 U	450 U	350 U	390 U
Carbazole	350 U	350 U	240 J	350 U	390 U
2,4-Dichlorophenol	350 U	350 U	450 U	350 U	390 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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TABLE 2.2 - 11 (cont.)

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	BS06		BS07	BS08
	03/25/92 SAMPLE	03/25/92 DUPLICATE	03/25/92	03/25/92
Naphthalene	350 U	350 U	390 U	400 U
2-Methylnaphthalene	350 U	350 U	390 U	400 U
Acenaphthylene	350 U	350 U	390 U	400 U
Acenaphthene	350 U	350 U	390 U	400 U
Dibenzofuran	350 U	350 U	390 U	400 U
Fluorene	350 U	350 U	390 U	400 U
Phenanthrene	350 U	350 U	390 U	400 U
Anthracene	350 U	350 U	390 U	400 U
Fluoranthene	350 U	350 U	390 U	400 U
Pyrene	350 U	350 U	390 U	400 U
Benzo(ghi)perylene	89 J	350 U	390 U	400 U
Benzo(a)anthracene	350 U	350 U	390 U	400 U
Benzo(b)fluoranthene	350 U	350 U	390 U	400 U
Benzo(k)fluoranthene	350 U	350 U	390 U	400 U
Benzo(a)pyrene	350 U	350 U	390 U	400 U
Chrysene	350 U	350 U	390 U	400 U
Dibenzo(ah)anthracene	350 U	350 U	390 U	400 U
Indeno(1,2,3,cd)pyrene	350 U	350 U	390 U	400 U
Sum of Carcinogenic PAHs	ND	ND	ND	ND
Sum of PAHs	89	ND	ND	ND
PHENOLIC COMPOUNDS				
Phenol	350 UJ	350 UJ	390 UJ	400 UJ
2-Chlorophenol	350 U	350 U	390 U	400 U
o-Cresol	350 U	350 U	390 U	400 U
p-Cresol	350 U	350 U	390 U	400 U
2-Nitrophenol	350 U	350 U	390 U	400 U
2,4-Dimethylphenol	350 U	350 U	390 U	400 U
4-Chloro-3-methylphenol	350 U	350 U	390 U	400 U
2,4,6-Trichlorophenol	350 U	350 U	390 U	400 U
2,4,5-Trichlorophenol	840 U	850 U	950 U	960 U
2,4-Dinitrophenol	840 U	850 U	950 U	960 U
4-Nitrophenol	840 U	850 U	950 U	960 U
2-Methyl-4,6-dinitrophenol	840 U	850 U	950 U	960 U
Pentachlorophenol	840 U	850 U	950 U	960 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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TABLE 2.2 - 11 (cont.)

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

OTHER SEMI-VOLATILE COMPOUNDS	BS06		BS07	BS08
	03/25/92 SAMPLE	03/25/92 DUPLICATE	03/25/92	03/25/92
Bis(2-chloroethyl)ether	350 U	350 U	390 U	400 U
1,3-Dichlorobenzene	350 U	350 U	390 U	400 U
1,4-Dichlorobenzene	350 U	350 U	390 U	400 U
1,2-Dichlorobenzene	350 U	350 U	390 U	400 U
Bis(2-chloroisopropyl)ether	350 U	350 U	390 U	400 U
N-Nitrosodi-n-propylamine	350 U	350 U	390 U	400 U
Hexachloroethane	350 U	350 U	390 U	400 U
Nitrobenzene	350 U	350 U	390 U	400 U
Isophorone	350 U	350 U	390 U	400 U
Bis(2-chloroethoxy)methane	350 U	350 U	390 U	400 U
1,2,4-Trichlorobenzene	350 U	350 U	390 U	400 U
4-Chloroaniline	350 U	350 U	390 U	400 U
Hexachlorobutadiene	350 U	350 U	390 U	400 U
Hexachlorocyclopentadiene	350 U	350 U	390 U	400 U
2-Chloronaphthalene	350 U	350 U	390 U	400 U
2-Nitroaniline	840 U	850 U	950 U	960 U
Dimethyl phthalate	350 U	350 U	390 U	400 U
2,6-Dinitrotoluene	350 U	350 U	390 U	400 U
3-Nitroaniline	840 U	850 U	950 U	960 U
2,4-Dinitrotoluene	350 U	350 U	390 U	400 U
Diethyl phthalate	350 U	350 U	390 U	400 U
4-Chlorophenyl phenyl ether	350 U	350 U	390 U	400 U
4-Nitroaniline	840 U	850 U	950 U	960 U
N-Nitrosodiphenylamine	350 U	350 U	390 U	400 U
4-Bromophenyl phenyl ether	350 U	350 U	390 U	400 U
Hexachlorobenzene	350 U	350 U	390 U	400 U
Di-n-butyl phthalate	350 U	350 U	390 U	400 U
Butyl benzyl phthalate	350 U	350 U	390 U	400 U
3,3-Dichlorobenzidine	350 U	350 U	390 U	400 U
Bis(2-ethylhexyl)phthalate	350 U	350 U	390 U	400 U
Di-n-octyl phthalate	350 U	350 U	390 U	400 U
Carbazole	350 U	350 U	390 U	400 U
2,4-Dichlorophenol	350 U	350 U	390 U	400 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

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08/20/92

TABLE 2.2 - 12

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
PESTICIDES AND PCBs

(concentrations in ug/kg)

	BS01	BS02	BS03	BS04	BS05
	-----	-----	-----	-----	-----
	03/05/92	03/05/92	03/05/92	03/05/92	03/05/92
a-BHC	1.8 U	1.8 U	120 U	7.2 U	2.0 U
b-BHC	1.8 U	1.8 U	120 U	7.2 U	2.0 U
d-BHC	1.8 U	1.8 U	120 U	7.2 U	2.0 U
g-BHC (Lindane)	1.8 U	1.8 U	120 U	7.2 U	2.0 U
Heptachlor	1.8 U	1.8 U	120 U	7.2 U	2.0 U
Aldrin	1.8 U	1.8 U	120 U	7.2 U	2.0 U
Heptachlor Epoxide	1.8 U	1.8 U	120 U	7.2 U	2.0 U
Endosulfan I	1.8 U	1.8 U	120 U	7.2 U	2.0 U
Dieldrin	3.5 U	3.5 U	230 U	14 U	3.9 U
4,4'-DDE	3.5 U	3.5 U	230 U	14 U	3.9 U
Endrin	3.5 U	3.5 U	230 U	14 U	3.9 U
Endosulfan II	3.5 U	3.5 U	230 U	14 U	3.9 U
4,4'-DDD	3.5 U	3.5 U	230 U	14 U	3.9 U
Endosulfan Sulfate	3.5 U	3.5 U	230 U	14 U	3.9 U
4,4'-DDT	3.5 U	3.5 U	230 U	14 U	3.9 U
Methyloxychlor	18 U	18 U	1200 U	72 U	20 U
Endrin Ketone	3.5 U	3.5 U	230 U	14 U	3.9 U
Endrin Aldehyde	3.5 U	3.5 U	230 U	14 U	3.9 U
cis-Chlordane	1.8 U	1.4 J	120 U	7.2 U	2.0 U
trans-Chlordane	1.8 U	1.2 J	120 U	7.2 U	2.0 U
Toxaphene	180 U	180 U	12000 U	720 U	200 U
PCB-1016	35 U	35 U	2300 U	140 U	39 U
PCB-1221	71 U	71 U	4600 U	280 U	80 U
PCB-1232	35 U	35 U	2300 U	140 U	39 U
PCB-1242	35 U	35 U	2300 U	140 U	39 U
PCB-1248	35 U	35 U	23000 C	1500	39 U
PCB-1254	35 U	35 U	2300 U	140 U	39 U
PCB-1260	35 U	35 U	850 J	69 J	39 U

U Not detected.

J Associated value is an estimate.

C Presence of the compound was confirmed by GC/MS.

.012

07/21/92

TABLE 2.2 - 12 (cont.)

SOIL QUALITY DATA
BACKGROUND SOIL SAMPLES
PESTICIDES AND PCBS

(concentrations in ug/kg)

	BS06		BS07	BS08
	03/25/92	03/25/92	03/25/92	03/25/92
	SAMPLE	DUPLICATE		
a-BHC	1.8 U	1.8 U	2.0 U	2.0 U
b-BHC	1.8 U	1.8 U	2.0 U	2.0 U
d-BHC	1.8 U	1.8 U	2.0 U	2.0 U
g-BHC (Lindane)	1.8 U	1.8 U	2.0 U	2.0 U
Heptachlor	2.5	2.0	2.0 U	2.0 U
Aldrin	1.8 U	1.8 U	2.0 U	2.0 U
Heptachlor Epoxide	5.5 P	6.9 P	2.0 U	2.0 U
Endosulfan I	1.8 U	1.8 U	2.0 U	2.0 U
Dieldrin	3.5 U	3.5 U	3.9 U	4.0 U
4,4'-DDE	3.5 U	3.5 U	3.9 U	4.0 U
Endrin	3.5 U	3.5 U	3.9 U	4.0 U
Endosulfan II	3.5 U	3.5 U	3.9 U	4.0 U
4,4'-DDD	3.5 U	3.5 U	3.9 U	4.0 U
Endosulfan Sulfate	3.5 U	3.5 U	3.9 U	4.0 U
4,4'-DDT	3.5 U	3.5 U	3.9 U	4.0 U
Methyloxyclo	18 U	18 U	20 U	20 U
Endrin Ketone	3.5 U	3.5 U	3.9 U	4.0 U
Endrin Aldehyde	3.5 U	3.5 U	3.9 U	4.0 U
cis-Chlordane	28	31	2.0 U	2.0 U
trans-Chlordane	16	18	2.0 U	2.0 U
Toxaphene	180 U	180 U	200 U	200 U
PCB-1016	35 U	35 U	39 U	40 U
PCB-1221	71 U	71 U	80 U	81 U
PCB-1232	35 U	35 U	39 U	40 U
PCB-1242	35 U	35 U	39 U	40 U
PCB-1248	35 U	35 U	1200	700
PCB-1254	35 U	35 U	39 U	40 U
PCB-1260	35 U	35 U	56	58

U Not detected.

J Associated value is an estimate.

P Greater than 25 percent difference for detected concentrations between primary and confirmation GC columns. Result reported is the lower of the two values.

.012

07/21/92

TABLE 2.2 - 13

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
INORGANICS

(concentrations in mg/kg)

	SS01	SS02	SS03	SS04	SS05	SS06	SS07
	03/10/92	03/06/92 SAMPLE	03/06/92 DUPLICATE	03/06/92	03/06/92	03/11/92	03/10/92
Aluminum	6690	1550	892	3520	1530	1830	6120
Antimony	2.5 R	2.7 UJ	2.7 UJ	2.9 UJ	2.6 UJ	2.6 UJ	2.6 R
Arsenic	7.2	1.1 U	0.91 U	5.6	2.6	3.7	4.2
Barium	38.5 BJ	8.3 BJ	5.5 BJ	52.7 BJ	15.0 BJ	19.4 BJ	23.3 BJ
Beryllium	0.40 B	0.23 UJ	0.11 UJ	0.95 BJ	0.39 UJ	0.26 UJ	0.39 B
Cadmium	0.68 UJ	0.73 U	0.72 U	0.79 U	0.70 U	0.70 U	1.9 J
Calcium	11200	18600	21300	23300	13000	26700	13700
Chromium, total	13.9	4.3	4.0 U	7.6	4.6	5.4	12.2
Cobalt	6.4 B	1.7 B	1.8 B	4.7 B	3.4 B	3.2 B	6.9 B
Copper	18.1	5.4 B	4.6 B	17.2	13.0	16.7	19.7
Iron	18400	2590	2350	10000	6440	5350	13300
Lead	11.7 J	2.5 J	3.0 J	13.6 J	8.0 J	9.7 J	10.8 J
Magnesium	6970	8990	10900	10200	7240	13300	8640
Manganese	484 J	85.5	88.8	152	115	146	399 J
Mercury	0.08 U	0.08 U	0.08 U	0.09 U	0.09 U	0.09 U	0.07 U
Nickel	15.1	4.1 U	3.6 U	13.3	9.9	8.0 B	17.0
Potassium	866 B	263 UJ	210 UJ	411 UJ	252 UJ	313 UJ	684 B
Selenium	0.57 BJ	0.32 U	0.32 U	0.54 B	0.31 U	0.31 U	0.54 BJ
Silver	0.48 B	0.52 U	0.42 U	0.47 U	0.41 U	0.46 U	0.41 U
Sodium	1240	377 UJ	321 UJ	484 UJ	321 UJ	396 UJ	239 B
Thallium	0.38 UJ	0.41 U	0.41 U	0.45 U	0.39 U	0.40 U	0.40 UJ
Vanadium	20.7	5.7 B	4.4 B	13.3 B	8.6 B	8.5 B	17.7
Zinc	85.4	20.3	17.7	138	45.0	47.8	62.4
Cyanide	--	--	--	--	--	--	--
	SS08	SS09	SS10	SS11	SS12	SS13	SS15
	03/11/92	03/11/92	03/11/92	03/11/92	03/11/92	03/12/92	03/07/92
Aluminum	3490	12500	3720	1100	913	919	1730 J
Antimony	3.5 R	2.7 R	2.8 BJ	2.5 R	2.7 R	3.2 BJ	3.9 UJ
Arsenic	91.5	8.7	6.3	1.4 B	1.3 B	1.5 B	3.6 UJ
Barium	56.7 B	105	36.3 B	5.8 B	4.6 B	4.9 B	7.7 BJ
Beryllium	0.66 B	0.61 B	0.33 B	0.04 U	0.07 U	0.10 U	0.18 U
Cadmium	1.2 BJ	0.72 UJ	0.69 UJ	0.67 UJ	0.72 UJ	0.75 BJ	1.0 U
Calcium	3430	10900	28100	25500	25000	24700	34300
Chromium, total	6.1	18.6	7.7	5.0	3.2	3.6	25.5
Cobalt	2.6 B	10.9 B	4.0 B	1.1 B	3.7 B	1.3 B	3.0 B
Copper	18.9	24.1	12.5	10.5	7.7	4.3 U	13.1
Iron	4930	21200	9210	2970	2780	2790	4340
Lead	18.6 J	12.2 J	17.8	3.8 J	3.8 J	3.1 J	3.8
Magnesium	1400 B	7880	15700	13200	12800	12800	17900
Manganese	52.0 J	973 J	190 J	111 J	167 J	107 J	157
Mercury	0.11 U	0.08 U	0.08 U	0.08 U	0.09 U	0.08 U	0.11 U
Nickel	6.5 U	21.0	8.3 B	5.1 U	4.9 U	4.2 U	4.7 B
Potassium	261 B	1180 B	374 B	162 U	173 U	165 U	370 B
Selenium	12.5 J	0.55 UJ	0.84 UJ	0.44 UJ	0.34 UJ	0.48 UJ	0.46 UJ
Silver	0.56 U	0.45 U	0.40 U	0.39 U	0.42 U	0.40 U	0.62 U
Sodium	382 U	274 U	241 U	295 U	233 U	284 U	450 U
Thallium	2.7 UJ	2.0 UJ	1.9 UJ	1.9 UJ	2.0 UJ	1.9 UJ	0.59 U
Vanadium	5.1 B	29.9	11.5 B	6.3 B	4.5 B	4.7 B	9.8 B
Zinc	29.8	65.4	50.1	33.0	32.3	17.7	29.4
Cyanide	--	--	--	--	--	--	--

-- Not analyzed.

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).
and confirmation GC columns. Result reported is the lower of the two values.

R Unusable.

.024

07/21/92

TABLE 2.2 - 13 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
INORGANICS

(concentrations in mg/kg)

	SS16	SS17
	-----	-----
	03/07/92	03/07/92
Aluminum	3900 J	1250 J
Antimony	2.7 UJ	2.4 UJ
Arsenic	10.8 J	1.1 UJ
Barium	59.4 J	7.4 BJ
Beryllium	0.82 B	0.15 U
Cadmium	1.1 B	0.65 U
Calcium	35200	22900
Chromium, total	10.2	4.4 U
Cobalt	5.3 B	2.0 B
Copper	22.3	5.9
Iron	4880	4210
Lead	10.5	4.7
Magnesium	13500	12200
Manganese	49.8	102
Mercury	0.18	0.07 U
Nickel	12.2	4.9 B
Potassium	430 B	210 B
Selenium	0.57 BJ	0.29 UJ
Silver	0.61 B	0.50 B
Sodium	466 U	340 U
Thallium	0.42 U	0.37 U
Vanadium	10.5 B	7.1 B
Zinc	21.9	163
Cyanide	--	--

-- Not analyzed.

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

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07/21/92

TABLE 2.2 - 14

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS01	SS02		SS03	SS04	SS05	SS06	SS07
	-----	-----	-----	-----	-----	-----	-----	-----
	03/10/92	03/06/92	03/06/92	03/06/92	03/06/92	03/06/92	03/11/92	03/10/92
		Sample	Duplicate					
Chloromethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Bromomethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Vinyl Chloride	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Chloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Methylene Chloride	12 U	33 U	49 U	72	120	20 U	20 U	18 U
Acetone	12 U	36 U	37 U	16 U	29	12 U	17 U	31 U
Carbondisulfide	12 U	3 J	4 J	6 J	7 J	12 U	13 U	12 U
1,1-Dichloroethylene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,1-Dichloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,2-Dichloroethylene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Chloroform	4 J	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,2-Dichloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Methyl Ethyl Ketone	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 J
1,1,1-Trichloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Carbon Tetrachloride	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Bromodichloromethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,2-Dichloropropane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Cis-1,3-Dichloro-1-propene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Trichloroethylene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Chlorodibromomethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,1,2-Trichloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Trans-1,3-Dichloro-1-propene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Bromoform	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Methyl Isobutyl Ketone	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
2-Hexanone	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Tetrachloroethylene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
1,1,2,2-Tetrachloroethane	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Chlorobenzene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Styrene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	12 U
Benzene	12 U	12 U	12 U	1 J	13 U	12 U	13 U	12 U
Ethyl Benzene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	3 J
Toluene	12 U	12 U	12 U	12 U	13 U	12 U	13 U	1 J
Xylenes	12 U	4 J	5 J	12 U	5 J	12 U	13 U	10 J
Sum of BETX	ND	4	5	1	5	ND	ND	14

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

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08/20/92

TABLE 2.2 - 14 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS08	SS09	SS10	SS11	SS12	SS13	SS14	SS15
	-----	-----	-----	-----	-----	-----	-----	-----
	03/11/92	03/11/92	03/11/92	03/11/92	03/11/92	03/12/92	03/12/92	03/07/92
Chloromethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Bromomethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Vinyl Chloride	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Chloroethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Methylene Chloride	71 U	22 U	12 U	11 U	17 U	11 U	26 U	36 U
Acetone	21 U	12 U	12 U	16 U	20 U	25 U	28 U	21 U
Carbondisulfide	4 J	12 U	12 U	11 U	12 U	11 U	3 J	12 U
1,1-Dichloroethylene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,1-Dichloroethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,2-Dichloroethylene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Chloroform	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,2-Dichloroethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Methyl Ethyl Ketone	13 J	12 U	12 U	9 J	12 U	10 J	13 J	12 U
1,1,1-Trichloroethane	17 U	12 U	12 U	11 U	12 U	11 U	6 J	12 U
Carbon Tetrachloride	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Bromodichloromethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,2-Dichloropropane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Cis-1,3-Dichloro-1-propene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Trichloroethylene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Chlorodibromomethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,1,2-Trichloroethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Trans-1,3-Dichloro-1-propene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Bromoform	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Methyl Isobutyl Ketone	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
2-Hexanone	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Tetrachloroethylene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
1,1,2,2-Tetrachloroethane	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Chlorobenzene	17 U	12 U	12 U	11 U	12 U	11 U	14 U	12 U
Styrene	17 U	12 U	12 U	11 U	12 U	11 U	5 J	12 U
Benzene	17 U	12 U	12 U	11 U	12 U	11 U	35	12 U
Ethyl Benzene	17 U	12 U	12 U	11 U	12 U	11 U	5 J	12 U
Toluene	17 U	12 U	12 U	11 U	12 U	11 U	7 J	12 U
Xylenes	17 U	12 U	12 U	11 U	12 U	11 U	47	2 J
Sum of BETX	ND	ND	ND	ND	ND	ND	94	2

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

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08/20/92

TABLE 2.2 - 14 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS16	SS17
	-----	-----
	03/07/92	03/07/92
Chloromethane	12 U	11 U
Bromomethane	12 U	11 U
Vinyl Chloride	12 U	11 U
Chloroethane	12 U	11 U
Methylene Chloride	17 U	38 U
Acetone	12 U	16 U
Carbondisulfide	2 J	3 J
1,1-Dichloroethylene	12 U	11 U
1,1-Dichloroethane	12 U	11 U
1,2-Dichloroethylene	12 U	11 U
Chloroform	4 J	11 U
1,2-Dichloroethane	12 U	11 U
Methyl Ethyl Ketone	12 U	11 U
1,1,1-Trichloroethane	12 U	11 U
Carbon Tetrachloride	12 U	11 U
Bromodichloromethane	12 U	11 U
1,2-Dichloropropane	12 U	11 U
Cis-1,3-Dichloro-1-propene	12 U	11 U
Trichloroethylene	1 J	11 U
Chlorodibromomethane	12 U	11 U
1,1,2-Trichloroethane	12 U	11 U
Trans-1,3-Dichloro-1-propene	12 U	11 U
Bromoform	12 U	11 U
Methyl Isobutyl Ketone	12 U	11 U
2-Hexanone	12 U	11 U
Tetrachloroethylene	12 U	11 U
1,1,2,2-Tetrachloroethane	12 U	11 U
Chlorobenzene	12 U	11 U
Styrene	12 U	11 U
Benzene	12 U	11 U
Ethyl Benzene	12 U	11 U
Toluene	12 U	11 U
Xylenes	12 U	1 J
Sum of BETX	ND	1

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

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08/20/92

TABLE 2.2 - 15

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS01	SS02		SS03	SS04	SS05
	-----	-----	-----	-----	-----	-----
PROJECT SPECIFIC	03/10/92	03/06/92	03/06/92	03/06/92	03/06/92	03/06/92
PAH COMPOUNDS		SAMPLE	DUPLICATE			
Naphthalene	380 U	390 U	390 U	300 J	140 J	2000
2-Methylnaphthalene	380 U	390 U	390 U	430	150 J	230 J
Acenaphthylene	380 U	390 U	390 U	430 U	390 U	210 J
Acenaphthene	380 U	390 U	390 U	430 U	390 U	220 J
Dibenzofuran	380 U	390 U	390 U	260 J	96 J	260 J
Fluorene	380 U	390 U	390 U	430 U	42 J	330 J
Phenanthrene	39 J	170 J	59 J	1800	770	2300
Anthracene	380 U	220 J	390 U	120 J	79 J	1700
Fluoranthene	49 J	320 J	150 J	550	330 J	4700
Pyrene	41 J	240 J	120 J	410 J	300 J	3400
Benzo(ghi)perylene	380 U	62 J	41 J	87 J	98 J	510
Benzo(a)anthracene	380 U	96 J	69 J	200 J	190 J	2100
Benzo(b)fluoranthene	380 U	100 J	74 J	150 J	180 J	1200
Benzo(k)fluoranthene	380 U	150 J	90 J	150 J	170 J	1300
Benzo(a)pyrene	380 U	82 J	49 J	130 J	130 J	1000
Chrysene	40 J	180 J	99 J	300 J	340 J	2300
Dibenzo(ah)anthracene	380 U	390 U	390 U	430 U	44 J	340 J
Indeno(1,2,3,cd)pyrene	380 U	83 J	56 J	72 J	110 J	700
Sum of Carcinogenic PAHs	40	690	440	1000	1200	8900
Sum of PAHs	170	1700	810	5000	3200	25000
PHENOLIC COMPOUNDS						
Phenol	380 U	390 U	390 U	430 U	390 U	400 U
2-Chlorophenol	380 U	390 U	390 U	430 U	390 U	400 U
o-Cresol	380 U	390 U	390 U	430 U	390 U	400 U
p-Cresol	380 U	390 U	390 U	430 U	390 U	400 U
2-Nitrophenol	380 U	390 U	390 U	430 U	390 U	400 U
2,4-Dimethylphenol	380 U	390 U	390 U	430 U	390 U	400 U
4-Chloro-3-methylphenol	380 U	390 U	390 U	430 U	390 U	400 U
2,4,6-Trichlorophenol	380 U	390 U	390 U	430 U	390 U	400 U
2,4,5-Trichlorophenol	920 U	950 U	940 U	1000 U	950 U	960 U
2,4-Dinitrophenol	920 U	950 U	940 U	1000 U	950 U	960 U
4-Nitrophenol	920 U	950 U	940 U	1000 U	950 U	960 U
2-Methyl-4,6-dinitrophenol	920 U	950 U	940 U	1000 U	950 U	960 U
Pentachlorophenol	920 U	950 U	940 U	1000 U	950 U	960 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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08/20/92

TABLE 2.2 - 15 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS01	SS02	SS03	SS04	SS05
	-----	-----	-----	-----	-----
	03/10/92	03/06/92 SAMPLE	03/06/92 DUPLICATE	03/06/92	03/06/92
OTHER SEMI-VOLATILE COMPOUNDS					
Bis(2-chloroethyl)ether	380 U	390 U	390 U	430 U	390 U
1,3-Dichlorobenzene	380 U	390 U	390 U	430 U	390 U
1,4-Dichlorobenzene	380 U	390 U	390 U	430 U	390 U
1,2-Dichlorobenzene	380 U	390 U	390 U	430 U	390 U
Bis(2-chloroisopropyl)ether	380 U	390 U	390 U	430 U	390 U
N-Nitrosodi-n-propylamine	380 U	390 U	390 U	430 U	390 U
Hexachloroethane	380 U	390 U	390 U	430 U	390 U
Nitrobenzene	380 U	390 U	390 U	430 U	390 U
Isophorone	380 U	390 U	390 U	430 U	390 U
Bis(2-chloroethoxy)methane	380 U	390 U	390 U	430 U	390 U
1,2,4-Trichlorobenzene	380 U	390 U	390 U	430 U	390 U
4-Chloroaniline	380 U	390 U	390 U	430 U	390 U
Hexachlorobutadiene	380 U	390 U	390 U	430 U	390 U
Hexachlorocyclopentadiene	380 U	390 U	390 U	430 U	390 U
2-Chloronaphthalene	380 U	390 U	390 U	430 U	390 U
2-Nitroaniline	920 U	950 U	940 U	1000 U	950 U
Dimethyl phthalate	380 U	390 U	390 U	430 U	390 U
2,6-Dinitrotoluene	380 U	390 U	390 U	430 U	390 U
3-Nitroaniline	920 U	950 U	940 U	1000 U	950 U
2,4-Dinitrotoluene	380 U	390 U	390 U	430 U	390 U
Diethyl phthalate	380 U	390 U	390 U	430 U	390 U
4-Chlorophenyl phenyl ether	380 U	390 U	390 U	430 U	390 U
4-Nitroaniline	920 U	950 U	940 U	1000 U	950 U
N-Nitrosodiphenylamine	380 U	390 U	390 U	430 U	390 U
4-Bromophenyl phenyl ether	380 U	390 U	390 U	430 U	390 U
Hexachlorobenzene	380 U	390 U	390 U	430 U	390 U
Di-n-butyl phthalate	51 J	390 U	390 U	430 U	390 U
Butyl benzyl phthalate	380 U	390 U	210 J	430 U	390 U
3,3-Dichlorobenzidine	380 U	390 U	390 U	430 U	390 U
Bis(2-ethylhexyl)phthalate	380 U	390 U	390 U	110 J	390 U
Di-n-octyl phthalate	380 U	390 U	390 U	430 U	390 U
Carbazole	380 U	110 J	390 U	71 J	46 J
2,4-Dichlorophenol	380 U	390 U	390 U	430 U	390 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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08/20/92

TABLE 2.2 - 15 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	SS06 ----- 03/11/92	SS07 ----- 03/10/92	SS08 ----- 03/11/92	SS09 ----- 03/11/92	SS10 ----- 03/11/92	SS11 ----- 03/11/92
Naphthalene	220 J	9400	5600	410 U	390 U	370 U
2-Methylnaphthalene	400 U	100 J	1300 J	410 U	390 U	370 U
Acenaphthylene	400 U	850	1900	410 U	390 U	43 J
Acenaphthene	400 U	150 J	210 J	410 U	390 U	370 U
Dibenzofuran	400 U	52 J	1700 J	410 U	390 U	370 U
Fluorene	400 U	390 U	3100	410 U	390 U	370 U
Phenanthrene	150 J	110 J	10000	410 U	150 J	80 J
Anthracene	400 U	390 U	3600	410 U	390 U	370 U
Fluoranthene	130 J	110 J	8600	410 U	380 J	370 J
Pyrene	100 J	48 J	6000	410 U	310 J	300 J
Benzo(ghi)perylene	400 U	390 U	1400 J	410 U	170 J	63 J
Benzo(a)anthracene	58 J	390 U	4600	410 U	240 J	120 J
Benzo(b)fluoranthene	65 J	40 J	3500	410 U	260 J	150 J
Benzo(k)fluoranthene	68 J	45 J	2800	410 U	280 J	200 J
Benzo(a)pyrene	55 J	390 U	2900	410 U	190 J	120 J
Chrysene	120 J	51 J	4800	410 U	300 J	220 J
Dibenzo(ah)anthracene	400 U	390 U	760 J	410 U	60 J	370 U
Indeno(1,2,3,cd)pyrene	400 U	390 U	2000	410 U	160 J	96 J
Sum of Carcinogenic PAHs	370	140	21000	ND	1500	900
Sum of PAHs	970	11000	64000	ND	2500	1800
PHENOLIC COMPOUNDS						
Phenol	400 U	390 U	14000	410 U	390 U	370 U
2-Chlorophenol	400 U	390 U	1900 U	410 U	390 U	370 U
o-Cresol	400 U	390 U	3000	410 U	390 U	370 U
p-Cresol	400 U	390 U	9300	410 U	390 U	370 U
2-Nitrophenol	400 U	390 U	1900 U	410 U	390 U	370 U
2,4-Dimethylphenol	400 U	390 U	910 J	410 U	390 U	370 U
4-Chloro-3-methylphenol	400 U	390 U	1900 U	410 U	390 U	370 U
2,4,6-Trichlorophenol	400 U	390 U	1900 U	410 U	390 U	370 U
2,4,5-Trichlorophenol	960 U	940 U	4600 U	990 U	940 U	900 U
2,4-Dinitrophenol	960 U	940 U	4600 U	990 U	940 U	900 U
4-Nitrophenol	960 U	940 U	4600 U	990 U	940 U	900 U
2-Methyl-4,6-dinitrophenol	960 U	940 U	4600 U	990 U	940 U	900 U
Pentachlorophenol	960 U	940 U	4600 U	990 U	940 U	900 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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08/20/92

TABLE 2.2 - 15 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS06 ----- 03/11/92	SS07 ----- 03/10/92	SS08 ----- 03/11/92	SS09 ----- 03/11/92	SS10 ----- 03/11/92	SS11 ----- 03/11/92
OTHER SEMI-VOLATILE COMPOUNDS						
Bis(2-chloroethyl)ether	400 U	390 U	1900 U	410 U	390 U	370 U
1,3-Dichlorobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
1,4-Dichlorobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
1,2-Dichlorobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
Bis(2-chloroisopropyl)ether	400 U	390 U	1900 U	410 U	390 U	370 U
N-Nitrosodi-n-propylamine	400 U	390 U	1900 U	410 U	390 U	370 U
Hexachloroethane	400 U	390 U	1900 U	410 U	390 U	370 U
Nitrobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
Isophorone	400 U	390 U	1900 U	410 U	390 U	370 U
Bis(2-chloroethoxy)methane	400 U	390 U	1900 U	410 U	390 U	370 U
1,2,4-Trichlorobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
4-Chloroaniline	400 U	390 U	1900 U	410 U	390 U	370 U
Hexachlorobutadiene	400 U	390 U	1900 U	410 U	390 U	370 U
Hexachlorocyclopentadiene	400 U	390 U	1900 U	410 U	390 U	370 U
2-Chloronaphthalene	400 U	390 U	1900 U	410 U	390 U	370 U
2-Nitroaniline	960 U	940 U	4600 U	990 U	940 U	900 U
Dimethyl phthalate	400 U	390 U	1900 U	410 U	390 U	370 U
2,6-Dinitrotoluene	400 U	390 U	1900 U	410 U	390 U	370 U
3-Nitroaniline	960 U	940 U	4600 U	990 U	940 U	900 U
2,4-Dinitrotoluene	400 U	390 U	1900 U	410 U	390 U	370 U
Diethyl phthalate	400 U	390 U	1900 U	410 U	390 U	370 U
4-Chlorophenyl phenyl ether	400 U	390 U	1900 U	410 U	390 U	370 U
4-Nitroaniline	960 U	940 U	4600 U	990 U	940 U	900 U
N-Nitrosodiphenylamine	400 U	390 U	1900 U	410 U	390 U	370 U
4-Bromophenyl phenyl ether	400 U	390 U	1900 U	410 U	390 U	370 U
Hexachlorobenzene	400 U	390 U	1900 U	410 U	390 U	370 U
Di-n-butyl phthalate	400 U	50 J	1900 U	410 U	390 U	370 U
Butyl benzyl phthalate	400 U	390 U	1900 U	410 U	390 U	370 U
3,3-Dichlorobenzidine	400 U	390 U	1900 U	410 U	390 U	370 U
Bis(2-ethylhexyl)phthalate	400 U	390 U	1900 U	410 U	280 J	350 J
Di-n-octyl phthalate	400 U	390 U	1900 U	410 U	390 U	370 U
Carbazole	400 U	390 U	2300	410 U	390 U	370 U
2,4-Dichlorophenol	400 U	390 U	1900 U	410 U	390 U	370 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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TABLE 2.2 - 15 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	SS12 ----- 03/11/92	SS13 ----- 03/12/92	SS14 ----- 03/12/92	SS15 ----- 03/07/92	SS16 ----- 03/07/92	SS17 ----- 03/07/92
Naphthalene	400 U	380 U	43000	370 U	130 J	290 J
2-Methylnaphthalene	400 U	380 U	15000	370 U	93 J	380
Acenaphthylene	400 U	380 U	24000	170 J	400 U	760
Acenaphthene	400 U	380 U	3000 J	370 U	400 U	610
Dibenzofuran	400 U	380 U	20000	370 U	400 U	840
Fluorene	400 U	380 U	37000	370 U	400 U	1500
Phenanthrene	400 U	100 J	220000	160 J	160 J	1400
Anthracene	400 U	380 U	31000	160 J	400 U	3800
Fluoranthene	400 U	160 J	64000	850	140 J	8000
Pyrene	400 U	130 J	50000	640	120 J	7000
Benzo(ghi)perylene	400 U	380 U	7500 J	270 J	46 J	920
Benzo(a)anthracene	400 U	60 J	30000	400	45 J	3300
Benzo(b)fluoranthene	400 U	68 J	21000	650	64 J	3000
Benzo(k)fluoranthene	400 U	67 J	22000	630	53 J	1400
Benzo(a)pyrene	400 U	51 J	21000	490	400 U	1900
Chrysene	400 U	94 J	26000	570	110 J	3800
Dibenzo(ah)anthracene	400 U	380 U	4300 J	120 J	400 U	550
Indeno(1,2,3,cd)pyrene	400 U	42 J	12000	410	400 U	1400
Sum of Carcinogenic PAHs	ND	380	140000	3300	270	15000
Sum of PAHs	ND	770	650000	5600	960	41000
PHENOLIC COMPOUNDS						
Phenol	400 U	380 U	1200 J	63 J	400 U	62 J
2-Chlorophenol	400 U	380 U	9200 U	370 U	400 U	370 U
o-Cresol	400 U	380 U	9200 U	370 U	400 U	370 U
p-Cresol	400 U	380 U	1200 J	370 U	400 U	370 U
2-Nitrophenol	400 U	380 U	9200 U	370 U	400 U	370 U
2,4-Dimethylphenol	400 U	380 U	9200 U	370 U	400 U	370 U
4-Chloro-3-methylphenol	400 U	380 U	9200 U	370 U	400 U	370 U
2,4,6-Trichlorophenol	400 U	380 U	9200 U	370 U	400 U	370 U
2,4,5-Trichlorophenol	960 U	930 U	22000 U	890 U	980 U	910 U
2,4-Dinitrophenol	960 U	930 U	22000 U	890 U	980 U	910 U
4-Nitrophenol	960 U	930 U	22000 U	890 U	980 U	910 U
2-Methyl-4,6-dinitrophenol	960 U	930 U	22000 U	890 U	980 U	910 U
Pentachlorophenol	960 U	930 U	22000 U	890 U	980 U	910 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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TABLE 2.2 - 15 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	SS12	SS13	SS14	SS15	SS16	SS17
	-----	-----	-----	-----	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	03/11/92	03/12/92	03/12/92	03/07/92	03/07/92	03/07/92
Bis(2-chloroethyl)ether	400 U	380 U	9200 U	370 U	400 U	370 U
1,3-Dichlorobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
1,4-Dichlorobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
1,2-Dichlorobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
Bis(2-chloroisopropyl)ether	400 U	380 U	9200 U	370 U	400 U	370 U
N-Nitrosodi-n-propylamine	400 U	380 U	9200 U	370 U	400 U	370 U
Hexachloroethane	400 U	380 U	9200 U	370 U	400 U	370 U
Nitrobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
Isophorone	400 U	380 U	9200 U	370 U	400 U	370 U
Bis(2-chloroethoxy)methane	400 U	380 U	9200 U	370 U	400 U	370 U
1,2,4-Trichlorobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
4-Chloroaniline	400 U	380 U	9200 U	370 U	400 U	370 U
Hexachlorobutadiene	400 U	380 U	9200 U	370 U	400 U	370 U
Hexachlorocyclopentadiene	400 U	380 U	9200 U	370 U	400 U	370 U
2-Chloronaphthalene	400 U	380 U	9200 U	370 U	400 U	370 U
2-Nitroaniline	960 U	930 U	22000 U	890 U	980 U	910 U
Dimethyl phthalate	400 U	380 U	9200 U	370 U	400 U	370 U
2,6-Dinitrotoluene	400 U	380 U	9200 U	370 U	400 U	370 U
3-Nitroaniline	960 U	930 U	22000 U	890 U	980 U	910 U
2,4-Dinitrotoluene	400 U	380 U	9200 U	370 U	400 U	370 U
Diethyl phthalate	400 U	380 U	9200 U	370 U	400 U	370 U
4-Chlorophenyl phenyl ether	400 U	380 U	9200 U	370 U	400 U	370 U
4-Nitroaniline	960 U	930 U	22000 U	890 U	980 U	910 U
N-Nitrosodiphenylamine	400 U	380 U	9200 U	370 U	400 U	370 U
4-Bromophenyl phenyl ether	400 U	380 U	9200 U	370 U	400 U	370 U
Hexachlorobenzene	400 U	380 U	9200 U	370 U	400 U	370 U
Di-n-butyl phthalate	400 U	380 U	9200 U	370 U	400 U	370 U
Butyl benzyl phthalate	400 U	380 U	9200 U	370 U	400 U	370 U
3,3-Dichlorobenzidine	400 U	380 U	9200 U	370 U	400 U	370 U
Bis(2-ethylhexyl)phthalate	85 J	300 J	9200 U	48 J	62 J	370 U
Di-n-octyl phthalate	400 U	380 U	9200 U	370 U	400 U	370 U
Carbazole	400 U	380 U	18000	45 J	400 U	1800
2,4-Dichlorophenol	400 U	380 U	9200 U	370 U	400 U	370 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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TABLE 2.2 - 16

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
PESTICIDES AND PCBS

(concentrations in ug/kg)

	SS01	SS02	SS02	SS03	SS04	SS05	SS06	SS07
	03/10/92	03/06/92	03/06/92	03/06/92	03/06/92	03/06/92	03/11/92	03/10/92
		SAMPLE	DUPLICATE					
a-BHC	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
b-BHC	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
d-BHC	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
g-BHC (Lindane)	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Heptachlor	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Aldrin	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Heptachlor Epoxide	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Endosulfan I	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Dieldrin	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
4,4'-DDE	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
Endrin	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
Endosulfan II	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
4,4'-DDD	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
Endosulfan Sulfate	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
4,4'-DDT	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
Methyloxychlor	20 U	20 U	20 U	22 U	40 U	20 U	20 U	100 U
Endrin Ketone	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
Endrin Aldehyde	3.8 U	3.9 U	3.9 U	4.3 U	7.9 U	4.0 U	4.0 U	20 U
cis-Chlordane	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
trans-Chlordane	2.0 U	2.0 U	2.0 U	2.2 U	4.0 U	2.0 U	2.0 U	10 U
Toxaphene	200 U	200 U	200 U	220 U	400 U	200 U	1000 U	1000 U
PCB-1016	38 U	39 U	39 U	43 U	79 U	40 U	200 U	200 U
PCB-1221	78 U	80 U	79 U	87 U	160 U	81 U	400 U	400 U
PCB-1232	38 U	39 U	39 U	43 U	79 U	40 U	200 U	200 U
PCB-1242	38 U	39 U	39 U	43 U	79 U	40 U	200 U	200 U
PCB-1248	160 P	39 U	39 U	490	79 U	790 P	200 U	200 U
PCB-1254	38 U	39 U	39 U	43 U	79 U	40 U	200 U	200 U
PCB-1260	38 U	39 U	39 U	43 U	79 U	40 U	200 U	200 U

U Not detected.

J Associated value is an estimate.

P Greater than 25 percent difference for detected concentrations between primary and confirmation GC columns. Result reported is the lower of the two values.

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TABLE 2.2 - 16 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
PESTICIDES AND PCBS

(concentrations in ug/kg)

	SS08	SS09	SS10	SS11	SS12	SS13	SS14	SS15
	-----	-----	-----	-----	-----	-----	-----	-----
	03/11/92	03/11/92	03/11/92	03/11/92	03/11/92	03/12/92	03/12/92	03/07/92
a-BHC	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
b-BHC	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
d-BHC	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
g-BHC (Lindane)	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Heptachlor	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Aldrin	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Heptachlor Epoxide	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Endosulfan I	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Dieldrin	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
4,4'-DDE	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
Endrin	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
Endosulfan II	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
4,4'-DDD	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
Endosulfan Sulfate	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
4,4'-DDT	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
Methoxychlor	120 UJ	21 UJ	60 UJ	19 UJ	20 UJ	20 UJ	240 UJ	38 U
Endrin Ketone	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
Endrin Aldehyde	24 U	4.1 U	12 U	3.7 U	4.0 U	3.8 U	46 U	7.4 U
cis-Chlordane	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
trans-Chlordane	12 U	2.1 U	6.0 U	1.9 U	2.0 U	2.0 U	24 U	3.8 U
Toxaphene	6000 U	210 U	600 U	190 U	200 U	200 U	12000 U	380 U
PCB-1016	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U
PCB-1221	2400 U	83 U	240 U	75 U	81 U	78 U	4600 U	140 U
PCB-1232	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U
PCB-1242	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U
PCB-1248	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U
PCB-1254	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U
PCB-1260	1200 U	41 U	120 U	37 U	40 U	38 U	2300 U	74 U

U Not detected.

J Associated value is an estimate.

.027

07/21/92

TABLE 2.2 - 16 (cont.)

SOIL QUALITY DATA
SURFICIAL SOIL SAMPLES
PESTICIDES AND PCBS

(concentrations in ug/kg)

	SS16	SS17
	-----	-----
	03/07/92	03/07/92
a-BHC	4.2 U	39 U
b-BHC	4.2 U	39 U
d-BHC	4.2 U	39 U
g-BHC (Lindane)	4.2 U	39 U
Heptachlor	4.2 U	39 U
Aldrin	4.2 U	39 U
Heptachlor Epoxide	4.2 U	39 U
Endosulfan I	4.2 U	39 U
Dieldrin	8.0 U	75 U
4,4'-DDE	8.0 U	75 U
Endrin	8.0 U	75 U
Endosulfan II	8.0 U	75 U
4,4'-DDD	8.0 U	75 U
Endosulfan Sulfate	8.0 U	75 U
4,4'-DDT	8.0 U	75 U
Methoxychlor	42 U	390 U
Endrin Ketone	8.0 U	75 U
Endrin Aldehyde	8.0 U	75 U
cis-Chlordane	4.2 U	39 U
trans-Chlordane	4.2 U	39 U
Toxaphene	420 U	3900 U
PCB-1016	80 U	750 U
PCB-1221	160 U	1500 U
PCB-1232	80 U	750 U
PCB-1242	80 U	750 U
PCB-1248	200 P	750 U
PCB-1254	80 U	750 U
PCB-1260	80 U	750 U

U Not detected.

P Greater than 25 percent difference for detected concentrations between primary and confirmation GC columns. Result reported is the lower of the two values.

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TABLE 2.2 - 17

SOIL QUALITY DATA
PILOT BORING SAMPLES
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	S80403 30.0'-32.0' ----- 03/20/92	S80601 22.5'-24.5' ----- 03/24/92	M430 26.0'-28.0' ----- 03/18/92
Chloromethane	13 U	13 U	12 U
Bromomethane	13 U	13 U	12 U
Vinyl Chloride	13 U	13 U	12 U
Chloroethane	13 U	13 U	12 U
Methylene Chloride	19 U	62 U	19
Acetone	170	110	25
Carbondisulfide	3 J	4 J	12 U
1,1-Dichloroethylene	13 U	13 U	12 U
1,1-Dichloroethane	13 U	13 U	12 U
1,2-Dichloroethylene	13 U	13 U	12 U
Chloroform	13 U	13 U	12 U
1,2-Dichloroethane	13 U	13 U	12 U
Methyl Ethyl Ketone	37	32	12 U
1,1,1-Trichloroethane	13 U	13 U	12 U
Carbon Tetrachloride	13 U	13 U	12 U
Bromodichloromethane	13 U	13 U	12 U
1,2-Dichloropropane	13 U	13 U	12 U
Cis-1,3-Dichloro-1-propene	13 U	13 U	12 U
Trichloroethylene	13 U	13 U	12 U
Chlorodibromomethane	13 U	13 U	12 U
1,1,2-Trichloroethane	13 U	13 U	12 U
Trans-1,3-Dichloro-1-propene	13 U	13 U	12 U
Bromoform	13 U	13 U	12 U
Methyl Isobutyl Ketone	13 U	13 U	12 U
2-Hexanone	13 U	3 J	12 U
Tetrachloroethylene	13 U	13 U	12 U
1,1,2,2-Tetrachloroethane	13 U	13 U	12 U
Chlorobenzene	13 U	13 U	12 U
Styrene	13 U	13 U	12 U
Benzene	19	110	12 U
Ethyl Benzene	13 U	2 J	12 U
Toluene	13 U	61	12 U
Xylenes	3 J	7 J	4 J
Sum of BETX	22	180	4

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

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TABLE 2.2 - 18

SOIL QUALITY DATA
PILOT BORING SAMPLES
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

	S80403 30.0'-32.0'	S80601 22.5'-24.5'	M43D 26.0'-28.0'
PROJECT SPECIFIC PAH COMPOUNDS	03/20/92	03/24/92	03/18/92
Naphthalene	4600 U	3450 J	6400 U
2-Methylnaphthalene	4600 U	8400 U	6400 U
Acenaphthylene	4600 U	8400 U	6400 U
Acenaphthene	4600 U	8400 U	6400 U
Dibenzofuran	4600 U	8400 U	6400 U
Fluorene	4600 U	8400 U	6400 U
Phenanthrene	4600 U	8400 U	6400 U
Anthracene	4600 U	8400 U	6400 U
Fluoranthene	4600 U	8400 U	6400 U
Pyrene	4600 U	8400 U	6400 U
Benzo(ghi)perylene	4600 U	8400 U	6400 U
Benzo(a)anthracene	4600 U	8400 U	6400 U
Benzo(b)fluoranthene	4600 U	8400 U	6400 U
Benzo(k)fluoranthene	4600 U	8400 U	6400 U
Benzo(a)pyrene	4600 U	8400 U	6400 U
Chrysene	4600 U	8400 U	6400 U
Dibenzo(ah)anthracene	4600 U	8400 U	6400 U
Indeno(1,2,3,cd)pyrene	4600 U	8400 U	6400 U
Sum of Carcinogenic PAHs	ND	ND	ND
Sum of PAHs	ND	3500	ND
PHENOLIC COMPOUNDS			
Phenol	35000	37000 J	71000
2-Chlorophenol	4600 U	8400 U	6400 U
o-Cresol	5300	5300 J	7000
p-Cresol	37000	41000	25000
2-Nitrophenol	4600 U	8400 U	6400 U
2,4-Dimethylphenol	3600 J	3900 J	2000 J
4-Chloro-3-methylphenol	4600 U	8400 U	6400 U
2,4,6-Trichlorophenol	4600 U	8400 U	6400 U
2,4,5-Trichlorophenol	11000 U	20000 U	16000 U
2,4-Dinitrophenol	11000 U	20000 U	16000 U
4-Nitrophenol	11000 U	20000 U	16000 U
2-Methyl-4,6-dinitrophenol	11000 U	20000 U	16000 U
Pentachlorophenol	11000 U	1400 J	16000 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

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08/20/92

TABLE 2.2-19
MONITORING WELL AND PIEZOMETER CONSTRUCTION

WELL	ELEVATION (FT. MSL)			WELL DEPTH (Ft.)	SCREEN LENGTH (Ft.)	SLOT SIZE (In.)	SAND PACK LENGTH (Ft.)	WELL DIAMETER (In.)	CASING AND SCREEN MATERIAL
	GROUND	RISER	BOTTOM						
MW-1S	586.0	587.76	568.0	18.0	5.0	0.010	7.5	2	SS
MW-ID	585.8	587.62	557.8	28.0	5.0	0.010	7.0	2	SS
MW-3S	585.2	588.24	572.2	13.0	10.5	0.010	12.0	2	SS
MW-3D	585.5	588.23	557.5	28.0	5.0	0.010	9.8	2	SS
MW-4S	586.2	589.17	572.2	14.0	10.3	0.010	13.0	2	SS
MW-4D	586.1	589.06	554.1	32.0	5.0	0.010	10.0	2	SS
MW-5S	585.4	587.89	570.4	15.0	10.4	0.010	13.2	2	SS
MW-5D	585.7	588.47	559.7	26.0	5.0	0.010	10.0	2	SS
MW-6S	585.7	588.45	572.2	13.5	10.0	0.010	11.0	2	SS
MW-6D	585.7	588.51	558.2	27.5	5.0	0.010	10.0	2	SS
P-101	585.0	588.14	571.0	14.0	10.0	0.010	12.5	2	PVC
P-102	585.6	588.52	571.6	14.0	9.96	0.010	12.5	2	PVC
P-103	586.4	589.44	571.9	14.5	9.95	0.010	13.0	2	PVC
P-104	586.0	589.07	572.0	14.0	9.95	0.010	13.0	2	PVC

TABLE 2.2-20
GROUNDWATER AND HARBOR LEVEL ELEVATIONS¹

MEASURING POINT	MEASURING POINT ELEVATION (FT. MSL)	WATER LEVEL ELEVATIONS (FT. MSL)					
		04/07/92	04/09/92	04/15/92	04/21/92	05/07/92	05/27/92
P-101	588.14	582.30	582.27	582.09	582.04	581.80	581.66
P-102	588.52	583.02	582.93	582.70	582.61	582.36	582.15
P-103	589.44	582.45	582.38	582.02	582.02	581.81	581.50
P-104	589.07	582.80	582.73	582.42	582.43	582.15	581.79
MW-1S	587.76	581.79	581.75	581.73	581.79	581.63	581.41
MW-1D	587.62	581.78	581.74	581.71	581.76	581.60	581.39
MW-3S	588.24	582.70	582.59	582.75	582.68	582.27	581.99
MW-3D	588.23	582.64	582.54	582.70	582.63	582.23	581.94
MW-4S	589.17	582.55	582.49	582.42	582.41	582.15	581.81
MW-4D	589.06	582.52	582.41	582.34	582.34	582.07	581.72
MW-5S	587.89	580.57	580.55	580.75	580.79	580.73	580.76
MW-5D	588.47	580.54	580.53	580.73	580.78	580.72	580.74
MW-6S	588.45	580.75	580.74	580.84	580.89	580.86	580.82
MW-6D	588.51	580.70	580.67	580.77	580.83	580.81	580.77
Harbor	584.65	--	--	580.4	580.4	580.5	580.5

-- Not measured.

¹See Figure 2.2-4 for monitoring well, piezometer, and harbor measuring point locations.

TABLE 2.2-21

HYDRAULIC CONDUCTIVITY ESTIMATES¹

WELL	LITHOLOGY OF SCREENING INTERVAL	HYDRAULIC CONDUCTIVITY (FT/DAY)	HYDRAULIC CONDUCTIVITY (CM/SEC)
MW-1S	Sand	16.3	5.8×10^{-3}
MW-1D	Sand	4.5	1.6×10^{-3}
MW-3S	Sand	4.7	1.7×10^{-3}
MW-3D	Sand with silt	10.7	3.8×10^{-3}
MW-4S	Sand	7.1	2.5×10^{-3}
MW-4D	Sand	3.8	1.3×10^{-3}
MW-5S	Sand	5.1	1.8×10^{-3}
MW-5D	Sand	13.8	4.9×10^{-3}
MW-6S	Sand	6.8	2.4×10^{-3}
MW-6D	Sand	1.1	3.9×10^{-4}
Geometric Mean		5.9	2.1×10^{-3}

¹Bouwer and Rice Method (Bouwer and Rice, 1976).

TABLE 2.2 - 22

GROUNDWATER QUALITY DATA
WATER TABLE MONITORING WELLS
INORGANICS

(concentrations in ug/L)

	MW1S1	MW3S1	MW4S1	MW5S1	MW6S1	
	04/09/92	04/07/92	04/07/92	04/08/92	04/08/92 SAMPLE	04/08/92 DUPLICATE
Aluminum	69.4 U	28.0 U	82.2 U	74.8 U	19.0 U	40.7 U
Antimony	10.9 U	10.9 UJ	10.9 UJ	16.5 UJ	10.9 UJ	10.9 UJ
Arsenic	120	134	18.4	243	350	387
Barium	79.8 B	184 B	204	129 BJ	153 BJ	148 BJ
Beryllium	0.19 U	0.19 UJ	0.19 UJ	0.42 UJ	0.19 UJ	0.22 UJ
Cadmium	2.9 U	3.2 BJ	2.9 UJ	2.9 UJ	4.3 BJ	2.9 UJ
Calcium	85200	117000	114000	84100	154000	142000
Chromium, total	2.1 UJ	2.1 UJ	2.1 UJ	2.1 BJ	2.1 UJ	2.1 UJ
Cobalt	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U	3.6 U
Copper	4.7 UJ	19.4 U	30.6	13.5 U	12.6 U	12.6 U
Iron	167 U	1040	224 U	30.9 UJ	305 J	241 UJ
Lead	0.92 U	1.8 B	0.92 U	0.92 U	1.1 B	3.2
Magnesium	32700	25100	27600	19300	41700	37900
Manganese	521	885	370	207	491	442
Mercury	0.16 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Nickel	13.4 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U
Potassium	3840 B	3460 B	2880 B	765 B	2170 B	2370 B
Selenium	1.6 UJ	2.6 BJ	1.2 UJ	1.7 BJ	2.9 BJ	2.0 BJ
Silver	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Sodium	30400 J	10900	35600	5030 J	8230 J	7920 J
Thallium	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Vanadium	6.1 U	1.7 U	1.7 U	1.7 U	3.2 B	4.1 B
Zinc	16.8 U	26.0 UJ	30.0 UJ	27.2 U	19.1 U	27.9 U
Cyanide	103	115	7.1 B	5.0 B	12.2	17.1

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

.001

07/21/92

GROUNDWATER QUALITY DATA
WATER TABLE MONITORING WELLS
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MW1S1	MW3S1	MW4S1	MW5S1	MW6S1	
	-----	-----	-----	-----	-----	-----
	04/09/92	04/07/92	04/07/92	04/08/92	04/08/92 SAMPLE	04/08/92 DUPLICATE
Chloromethane	10 U	10 U	10 U	50 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	50 U	10 U	10 U
Vinyl Chloride	10 U	10 U	10 U	50 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	50 U	10 U	10 U
Methylene Chloride	10 U	10 U	10 U	50 U	10 U	10 U
Acetone	10 U	6 J	5 J	50 U	11 U	10 U
Carbondisulfide	3 J	10 U	10 U	50 U	10 U	10 U
1,1-Dichloroethylene	10 U	10 U	10 U	12 J	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	700	10 U	10 U
1,2-Dichloroethylene	10 U	3 J	10 U	50 U	10 U	10 U
Chloroform	10 U	10 U	10 U	50 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	20 J	10 U	10 U
Methyl Ethyl Ketone	10 U	10 U	10 U	50 U	10 U	10 U
1,1,1-Trichloroethane	10 U	10 U	10 U	68	10 U	10 U
Carbon Tetrachloride	10 U	10 U	10 U	50 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	50 U	10 U	10 U
1,2-Dichloropropane	10 U	10 U	10 U	50 U	10 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	10 U	10 U	50 U	10 U	10 U
Trichloroethylene	10 U	3 J	10 U	50 U	10 U	10 U
Chlorodibromomethane	10 U	10 U	10 U	50 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	50 U	10 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	10 U	10 U	50 U	10 U	10 U
Bromoform	10 U	10 U	10 U	50 U	10 U	10 U
Methyl Isobutyl Ketone	10 U	10 U	10 U	50 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	50 U	10 U	10 U
Tetrachloroethylene	10 U	10 U	10 U	50 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	50 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	50 U	10 U	10 U
Styrene	3 J	10 U	10 U	50 U	7 J	8 J
Benzene	23	10 U	10 U	70	44	50
Ethyl Benzene	11	10 U	10 U	50 U	69	78
Toluene	7 J	10 U	10 U	50 U	23	25
Xylenes	39	10 U	10 U	50 U	100	120
Sum of BETX	80	ND	ND	70	240	270

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.003

08/20/92

TABLE 2.2 - 24

GROUNDWATER QUALITY DATA
WATER TABLE MONITORING WELLS
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

PROJECT SPECIFIC PAH COMPOUNDS	MW1S1 04/09/92	MW3S1 04/07/92	MW4S1 04/07/92	MW5S1 04/08/92	MW6S1 04/08/92 SAMPLE	04/08/92 DUPLICATE
Naphthalene	1500	20 U	20 U	10 U	1800	1100
2-Methylnaphthalene	72 J	20 U	20 U	10 U	20 J	17 J
Acenaphthylene	100 U	20 U	5 J	10 U	150 U	150 U
Acenaphthene	110	20 U	100	10 U	150	150
Dibenzofuran	46 J	20 U	25	10 U	48 J	49 J
Fluorene	46 J	20 U	62	10 U	19 J	20 J
Phenanthrene	27 J	20 U	43	10 U	150 U	150 U
Anthracene	100 U	20 U	9 J	10 U	150 U	150 U
Fluoranthene	100 U	20 U	45	10 U	150 U	150 U
Pyrene	100 U	20 U	32	10 U	150 U	150 U
Benzo(ghi)perylene	100 U	20 U	20 U	10 U	150 U	150 U
Benzo(a)anthracene	100 U	20 U	7 J	10 U	150 U	150 U
Benzo(b)fluoranthene	100 U	20 U	3 J	10 U	150 U	150 U
Benzo(k)fluoranthene	100 U	20 U	3 J	10 U	150 U	150 U
Benzo(a)pyrene	100 U	20 U	3 J	10 U	150 U	150 U
Chrysene	100 U	20 U	11 J	10 U	150 U	150 U
Dibenzo(ah)anthracene	100 U	20 U	20 U	10 U	150 U	150 U
Indeno(1,2,3,cd)pyrene	100 U	20 U	20 U	10 U	150 U	150 U
Sum of Carcinogenic PAHs	ND	ND	27	ND	ND	ND
Sum of PAHs	1800	ND	350	ND	2000	1300
PHENOLIC COMPOUNDS						
Phenol	100 U	110	450	47	340	340
2-Chlorophenol	100 U	20 U	20 U	10 U	150 U	150 U
o-Cresol	100 U	9 J	48 J	6 J	67 J	72 J
p-Cresol	23 J	26	150	20	110 J	110 J
2-Nitrophenol	100 U	20 U	20 U	10 U	150 U	150 U
2,4-Dimethylphenol	100 U	20 U	7 J	2 J	46 J	36 J
4-Chloro-3-methylphenol	100 U	20 U	20 U	10 U	150 U	150 U
2,4,6-Trichlorophenol	100 U	20 U	20 U	10 U	150 U	150 U
2,4,5-Trichlorophenol	250 U	50 U	50 U	25 U	380 U	380 U
2,4-Dinitrophenol	250 U	50 U	50 U	25 U	380 U	380 U
4-Nitrophenol	250 U	50 U	50 U	25 U	380 U	380 U
2-Methyl-4,6-dinitrophenol	250 U	50 U	50 U	25 U	380 U	380 U
Pentachlorophenol	250 U	50 U	50 U	25 U	380 U	380 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.006

08/20/92

TABLE 2.2 - 24 (cont.)

GROUNDWATER QUALITY DATA
WATER TABLE MONITORING WELLS
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MW1S1	MW3S1	MW4S1	MW5S1	MW6S1	
	-----	-----	-----	-----	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	04/09/92	04/07/92	04/07/92	04/08/92	04/08/92	04/08/92
Bis(2-chloroethyl)ether	100 U	20 U	20 U	10 U	150 U	150 U
1,3-Dichlorobenzene	100 U	20 U	20 U	10 U	150 U	150 U
1,4-Dichlorobenzene	100 U	20 U	20 U	10 U	150 U	150 U
1,2-Dichlorobenzene	100 U	20 U	20 U	10 U	150 U	150 U
Bis(2-chloroisopropyl)ether	100 U	20 U	20 U	10 U	150 U	150 U
N-Nitrosodi-n-propylamine	100 U	20 U	20 U	10 U	150 U	150 U
Hexachloroethane	100 U	20 U	20 U	10 U	150 U	150 U
Nitrobenzene	100 U	20 U	20 U	10 U	150 U	150 U
Isophorone	100 U	20 U	20 U	10 U	150 U	150 U
Bis(2-chloroethoxy)methane	100 U	20 U	20 U	10 U	150 U	150 U
1,2,4-Trichlorobenzene	100 U	20 U	20 U	10 U	150 U	150 U
4-Chloroaniline	100 U	20 U	20 U	10 U	150 U	150 U
Hexachlorobutadiene	100 U	20 U	20 U	10 U	150 U	150 U
Hexachlorocyclopentadiene	100 U	20 U	20 U	10 U	150 U	150 U
2-Chloronaphthalene	100 U	20 U	20 U	10 U	150 U	150 U
2-Nitroaniline	250 U	50 U	50 U	25 U	380 U	380 U
Dimethyl phthalate	100 U	20 U	20 U	10 U	150 U	150 U
2,6-Dinitrotoluene	100 U	20 U	20 U	10 U	150 U	150 U
3-Nitroaniline	250 U	50 U	50 U	25 U	380 U	380 U
2,4-Dinitrotoluene	100 U	20 U	20 U	10 U	150 U	150 U
Diethyl phthalate	100 U	20 U	20 U	10 U	150 U	150 U
4-Chlorophenyl phenyl ether	100 U	20 U	20 U	10 U	150 U	150 U
4-Nitroaniline	250 U	50 U	50 U	25 U	380 U	380 U
N-Nitrosodiphenylamine	100 U	20 U	20 U	10 U	150 U	150 U
4-Bromophenyl phenyl ether	100 U	20 U	20 U	10 U	150 U	150 U
Hexachlorobenzene	100 U	20 U	20 U	10 U	150 U	150 U
Di-n-butyl phthalate	100 U	20 U	20 U	10 U	150 U	150 U
Butyl benzyl phthalate	100 U	20 U	20 U	10 U	150 U	150 U
3,3-Dichlorobenzidine	100 U	20 U	20 U	10 U	150 U	150 U
Bis(2-ethylhexyl)phthalate	100 U	20 U	2 J	9 J	150 U	150 U
Di-n-octyl phthalate	100 U	20 U	20 U	10 U	150 U	150 U
Carbazole	86 J	20 U	12 J	10 U	110 J	95 J
2,4-Dichlorophenol	100 U	20 U	20 U	10 U	150 U	150 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.006

08/20/92

TABLE 2.2 - 25

GROUNDWATER QUALITY DATA
WATER TABLE MONITORING WELLS
PESTICIDES AND PCBs

(concentrations in ug/L)

	MW1S1	MW3S1	MW4S1	MW5S1	MW6S1	
	04/09/92	04/07/92	04/07/92	04/08/92	04/08/92 SAMPLE	04/08/92 DUPLICATE
a-BHC	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
b-BHC	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
d-BHC	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
g-BHC (Lindane)	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Heptachlor	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Aldrin	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Heptachlor Epoxide	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Endosulfan I	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Dieldrin	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
4,4'-DDE	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
Endrin	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
Endosulfan II	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
4,4'-DDD	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
Endosulfan Sulfate	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
4,4'-DDT	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
Methoxychlor	1.0 U	0.50 U	0.50 UJ	0.50 UJ	0.50 UJ	0.50 UJ
Endrin Ketone	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
Endrin Aldehyde	0.20 U	0.10 U	0.10 UJ	0.10 UJ	0.10 UJ	0.10 UJ
cis-Chlordane	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
trans-Chlordane	0.10 U	0.050 U	0.050 UJ	0.050 UJ	0.050 UJ	0.050 UJ
Toxaphene	10 U	5.0 U	5.0 UJ	5.0 UJ	5.0 UJ	5.0 UJ
PCB-1016	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ
PCB-1221	4.0 U	2.0 U	2.0 UJ	2.0 UJ	4.0 UJ	4.0 UJ
PCB-1232	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ
PCB-1242	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ
PCB-1248	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ
PCB-1254	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ
PCB-1260	2.0 U	1.0 U	1.0 UJ	1.0 UJ	2.0 UJ	2.0 UJ

U Not detected.

J Associated value is an estimate.

.008

03/18/93

TABLE 2.2 - 26

GROUNDWATER QUALITY DATA
DEEP MONITORING WELLS
INORGANICS

(concentrations in ug/L)

	MW1D1	MW3D1	MW4D1		MW5D1	MW6D1
	04/09/92	04/07/92	04/07/92 SAMPLE	04/07/92 DUPLICATE	04/08/92	04/08/92
Aluminum	79.7 U	58.9 U	135 U	128 U	34.8 U	76.3 U
Antimony	13.3 U	10.9 UJ	10.9 UJ	10.9 UJ	10.9 UJ	10.9 UJ
Arsenic	4020	7110	22400	27100	9220	14600
Barium	82.2 B	200 B	402	448	185 BJ	515 J
Beryllium	0.68 U	0.46 UJ	0.19 UJ	0.19 UJ	0.19 UJ	0.37 UJ
Cadmium	6.2	12.4 J	50.7 J	50.3 J	12.7 J	20.7 J
Calcium	9750	17100	37200	39300	21700	27800
Chromium, total	39.6 J	13.5 J	15.4 J	17.1 J	7.3 BJ	30.8 J
Cobalt	3.7 B	8.0 B	15.2 B	16.6 B	4.0 B	12.7 B
Copper	69.9 J	47.4	43.8	91.0	16.8 U	30.6
Iron	418	495	807	975	370 J	1200 J
Lead	15.7	3.8 J	4.1 J	2.2 BJ	1.3 BJ	4.2 J
Magnesium	5470	13200	20000	22400	18900	17500
Manganese	52.0	203	326	387	319	646
Mercury	0.16 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Nickel	41.1	20.3 U	46.7	82.2	12.0 U	34.1 U
Potassium	4490 B	13100	30000	34900	8960	17800
Selenium	46.0 J	7.2 BJ	6.0 UJ	6.8 BJ	2.4 BJ	12.0 BJ
Silver	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Sodium	15600 J	55400	170000	181000	332000 J	101000 J
Thallium	1.7 U	1.7 UJ	1.7 UJ	1.7 UJ	1.7 UJ	1.7 UJ
Vanadium	297	103	33.1 B	37.0 B	30.6 B	121
Zinc	61.2	59.4 UJ	72.0 UJ	84.2 UJ	29.0 U	58.2 U
Cyanide	448	200	706	662	526	632

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).

.005

07/21/92

TABLE 2.2 - 27

GROUNDWATER QUALITY DATA
DEEP MONITORING WELLS
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MW1D1	MW3D1	MW4D1		MW5D1	MW6D1
	04/09/92	04/07/92	04/07/92	04/07/92	04/08/92	04/08/92
			SAMPLE	DUPLICATE		
Chloromethane	40 U	62 U	40 U	40 U	40 U	100 U
Bromomethane	40 U	62 U	40 U	40 U	40 U	100 U
Vinyl Chloride	40 U	62 U	40 U	40 U	40 U	100 U
Chloroethane	40 U	62 U	40 U	40 U	40 U	100 U
Methylene Chloride	40 U	62 U	40 U	40 U	40 U	100 U
Acetone	360 J	840	860	820	40 U	760
Carbondisulfide	7 J	62 U	6 J	6 J	40 U	100 U
1,1-Dichloroethylene	40 U	62 U	40 U	40 U	40 U	100 U
1,1-Dichloroethane	40 U	62 U	40 U	40 U	14 J	100 U
1,2-Dichloroethylene	40 U	62 U	40 U	40 U	40 U	100 U
Chloroform	40 U	62 U	40 U	40 U	40 U	100 U
1,2-Dichloroethane	40 U	62 U	40 U	40 U	40 U	100 U
Methyl Ethyl Ketone	50	120	140	140	40 U	130
1,1,1-Trichloroethane	40 U	62 U	40 U	40 U	40 U	100 U
Carbon Tetrachloride	40 U	62 U	40 U	40 U	40 U	100 U
Bromodichloromethane	40 U	62 U	40 U	40 U	40 U	100 U
1,2-Dichloropropane	40 U	62 U	40 U	40 U	40 U	100 U
Cis-1,3-Dichloro-1-propene	40 U	62 U	40 U	40 U	40 U	100 U
Trichloroethylene	40 U	62 U	40 U	40 U	40 U	100 U
Chlorodibromomethane	40 U	62 U	40 U	40 U	40 U	100 U
1,1,2-Trichloroethane	40 U	62 U	40 U	40 U	40 U	100 U
Trans-1,3-Dichloro-1-propene	40 U	62 U	40 U	40 U	40 U	100 U
Bromoform	40 U	62 U	40 U	40 U	40 U	100 U
Methyl Isobutyl Ketone	40 U	62 U	40 U	40 U	40 U	100 U
2-Hexanone	40 U	62 U	40 U	40 U	40 U	100 U
Tetrachloroethylene	40 U	62 U	40 U	40 U	40 U	100 U
1,1,2,2-Tetrachloroethane	40 U	62 U	40 U	40 U	40 U	100 U
Chlorobenzene	40 U	62 U	40 U	40 U	40 U	100 U
Styrene	16 J	62 U	40 U	40 U	40 U	100 U
Benzene	700	1100	460	420	560	1500
Ethyl Benzene	10 J	62 U	40 U	40 U	40 U	120
Toluene	270	62 U	40 U	40 U	40 U	400
Xylenes	81	38 J	40 U	40 U	40 U	180
Sum of BETX	1100	1100	460	420	560	2200

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.014

08/20/92

TABLE 2.2 - 28

GROUNDWATER QUALITY DATA
DEEP MONITORING WELLS
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

PROJECT SPECIFIC PAH COMPOUNDS	MW1D1 ----- 04/09/92	MW3D1 ----- 04/07/92	MW4D1 ----- 04/07/92 SAMPLE 04/07/92 DUPLICATE		MW5D1 ----- 04/08/92	MW6D1 ----- 04/08/92
Naphthalene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2-Methylnaphthalene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Acenaphthylene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Acenaphthene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Dibenzofuran	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Fluorene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Phenanthrene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Anthracene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Fluoranthene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Pyrene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Benzo(ghi)perylene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Benzo(a)anthracene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Benzo(b)fluoranthene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Benzo(k)fluoranthene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Benzo(a)pyrene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Chrysene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Dibenzo(ah)anthracene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Indeno(1,2,3,cd)pyrene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Sum of Carcinogenic PAHs	ND	ND	ND	ND	ND	ND
Sum of PAHs	ND	ND	ND	ND	ND	ND
PHENOLIC COMPOUNDS						
Phenol	760000	94000	150000	320000	150 U	690000 J
2-Chlorophenol	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
o-Cresol	82000	210000	170000 J	34000 J	1200	99000
p-Cresol	260000	730000	710000	150000	38 J	460000
2-Nitrophenol	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2,4-Dimethylphenol	20000 J	39000 J	41000 J	7600 J	790	40000 J
4-Chloro-3-methylphenol	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2,4,6-Trichlorophenol	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2,4,5-Trichlorophenol	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
2,4-Dinitrophenol	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
4-Nitrophenol	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
2-Methyl-4,6-dinitrophenol	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
Pentachlorophenol	150000 U	250000 U	500000 U	120000 U	380 U	120000 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.006

08/20/92

TABLE 2.2 - 28 (cont.)

GROUNDWATER QUALITY DATA
DEEP MONITORING WELLS
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MJ1D1	MJ3D1	MJ4D1		MJ5D1	MJ6D1
	-----	-----	-----	-----	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	04/09/92	04/07/92	04/07/92 SAMPLE	04/07/92 DUPLICATE	04/08/92	04/08/92
Bis(2-chloroethyl)ether	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
1,3-Dichlorobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
1,4-Dichlorobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
1,2-Dichlorobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Bis(2-chloroisopropyl)ether	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
N-Nitrosodi-n-propylamine	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Hexachloroethane	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Nitrobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Isophorone	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Bis(2-chloroethoxy)methane	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
1,2,4-Trichlorobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
4-Chloroaniline	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Hexachlorobutadiene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Hexachlorocyclopentadiene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2-Chloronaphthalene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2-Nitroaniline	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
Dimethyl phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2,6-Dinitrotoluene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
3-Nitroaniline	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
2,4-Dinitrotoluene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Diethyl phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
4-Chlorophenyl phenyl ether	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
4-Nitroaniline	150000 U	250000 U	500000 U	120000 U	380 U	120000 U
N-Nitrosodiphenylamine	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
4-Bromophenyl phenyl ether	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Hexachlorobenzene	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Di-n-butyl phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Butyl benzyl phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
3,3-Dichlorobenzidine	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Bis(2-ethylhexyl)phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Di-n-octyl phthalate	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
Carbazole	60000 U	100000 U	200000 U	50000 U	150 U	50000 U
2,4-Dichlorophenol	60000 U	100000 U	200000 U	50000 U	150 U	50000 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

.006

08/20/92

TABLE 2.2 - 29

GROUNDWATER QUALITY DATA
DEEP MONITORING WELLS
PESTICIDES AND PCBS

(concentrations in ug/L)

	MW1D1	MW3D1	MW4D1		MW5D1	MW6D1
	04/09/92	04/07/92	04/07/92 SAMPLE	04/07/92 DUPLICATE	04/08/92	04/08/92
a-BHC	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
b-BHC	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
d-BHC	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
g-BHC (Lindane)	0.10 UJ	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Heptachlor	0.10 UJ	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Aldrin	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Heptachlor Epoxide	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Endosulfan I	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Dieldrin	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
4,4'-DDE	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
Endrin	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
Endosulfan II	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
4,4'-DDD	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
Endosulfan Sulfate	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
4,4'-DDT	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
Methoxychlor	1.0 U	0.50 U	0.50 U	0.50 U	0.50 UJ	5.0 UJ
Endrin Ketone	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
Endrin Aldehyde	0.20 U	0.10 U	0.10 U	0.10 U	0.10 UJ	1.0 UJ
cis-Chlordane	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
trans-Chlordane	0.10 U	0.050 U	0.050 U	0.050 U	0.050 UJ	0.50 UJ
Toxaphene	10 U	5.0 U	5.0 U	5.0 U	5.0 UJ	50 UJ
PCB-1016	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ
PCB-1221	4.0 U	10 U	10 U	10 U	4.0 UJ	50 UJ
PCB-1232	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ
PCB-1242	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ
PCB-1248	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ
PCB-1254	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ
PCB-1260	2.0 U	5.0 U	5.0 U	5.0 U	2.0 UJ	25 UJ

U Not detected.

J Associated value is an estimate.

.010

07/21/92

TABLE 2.3 - 1

BLANK WATER SAMPLE DATA
INORGANICS

(concentrations in ug/L)

	FIELD BLANKS	
	04/07/92	04/09/92
Aluminum	27.8 U	21.1 U
Antimony	10.9 UJ	10.9 U
Arsenic	0.94 U	0.95 U
Barium	0.63 B	1.6 U
Beryllium	0.19 UJ	0.19 U
Cadmium	2.9 UJ	2.9 U
Calcium	225 U	172 U
Chromium, total	2.1 UJ	2.1 UJ
Cobalt	3.6 U	3.6 U
Copper	11.8 U	6.1 UJ
Iron	35.0 U	17.4 U
Lead	2.7 B	0.92 U
Magnesium	21.3 U	21.3 U
Manganese	0.92 U	0.62 U
Mercury	0.0010 U	0.16 U
Nickel	3.8 U	6.0 U
Potassium	710 U	710 U
Selenium	1.2 UJ	1.2 UJ
Silver	1.7 U	1.7 U
Sodium	757 U	1220 UJ
Thallium	1.7 U	1.7 U
Vanadium	1.7 U	1.7 U
Zinc	23.7 UJ	6.2 U
Cyanide	1.8 U	1.8 U

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

.046

07/21/92

TABLE 2.3 - 2

BLANK SOIL SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	METHOD BLANKS							
	03/05/92	03/05/92	03/05/92	03/07/92	03/09/92	03/10/92	03/10/92	03/11/92
Chloromethane	10 U	10 UJ	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromomethane	10 U	10 UJ	1200 U	10 U	10 U	10 U	1200 U	10 U
Vinyl Chloride	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chloroethane	10 U	10 UJ	1200 U	10 U	10 U	10 U	1200 U	10 U
Methylene Chloride	5 J	10	170 J	10	9 J	9 J	240 J	9 J
Acetone	11	9 J	1200 U	9 J	5 J	5 J	740 J	5 J
Carbondisulfide	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1-Dichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1-Dichloroethane	10 U	10 UJ	1200 U	10 U	10 U	10 U	1200 U	10 U
1,2-Dichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chloroform	2 J	10 U	350 J	10 U	10 U	10 U	180 J	10 U
1,2-Dichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Methyl Ethyl Ketone	10 U	10 U	1200 U	10 U	10 U	10 U	900 J	10 U
1,1,1-Trichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Carbon Tetrachloride	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromodichloromethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,2-Dichloropropene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Trichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chlorodibromomethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1,2-Trichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromoform	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Methyl Isobutyl Ketone	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
2-Hexanone	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Tetrachloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chlorobenzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Styrene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Benzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Ethyl Benzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Toluene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Xylenes	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U

U Not detected.

J Associated value is an estimate.

.037

07/21/92

TABLE 2.3 - 2 (cont.)

BLANK SOIL SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	METHOD BLANKS							
	03/11/92	03/11/92	03/13/92	03/16/92	03/17/92	03/17/92	03/17/92	03/18/92
Chloromethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromomethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Vinyl Chloride	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Methylene Chloride	4 J	12	170 J	4 J	12	7 J	450 J	7 J
Acetone	10	10	1200 U	10	10	6 J	1200 U	6 J
Carbondisulfide	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1-Dichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1-Dichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,2-Dichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chloroform	2 J	2 J	350 J	2 J	2 J	10 U	1200 U	10 U
1,2-Dichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Methyl Ethyl Ketone	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1,1-Trichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Carbon Tetrachloride	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromodichloromethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,2-Dichloropropane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Trichloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chlorodibromomethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1,2-Trichloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Bromoform	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Methyl Isobutyl Ketone	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
2-Hexanone	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Tetrachloroethylene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Chlorobenzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Styrene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Benzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Ethyl Benzene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Toluene	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U
Xylenes	10 U	10 U	1200 U	10 U	10 U	10 U	1200 U	10 U

U Not detected.

J Associated value is an estimate.

.037

07/21/92

TABLE 2.3 - 2 (cont.)

BLANK SOIL SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	METHOD BLANKS						
	03/18/92	03/18/92	03/19/92	03/20/92	03/21/92	03/24/92	03/25/92
Chloromethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Bromomethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Vinyl Chloride	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Chloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Methylene Chloride	8 J	450 J	450 J	12	450 J	8 J	7 J
Acetone	9 J	1200 U	1200 U	10	1200 U	9 J	6 J
Carbondisulfide	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,1-Dichloroethylene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,1-Dichloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,2-Dichloroethylene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Chloroform	10 U	1200 U	1200 U	2 J	1200 U	10 U	10 U
1,2-Dichloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Methyl Ethyl Ketone	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,1,1-Trichloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Carbon Tetrachloride	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Bromodichloromethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,2-Dichloropropane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Trichloroethylene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Chlorodibromomethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,1,2-Trichloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Bromoform	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Methyl Isobutyl Ketone	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
2-Hexanone	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Tetrachloroethylene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Chlorobenzene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Styrene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Benzene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Ethyl Benzene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Toluene	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U
Xylenes	10 U	1200 U	1200 U	10 U	1200 U	10 U	10 U

U Not detected.

J Associated value is an estimate.

.037

07/21/92

TABLE 2.3 - 2 (cont.)

BLANK WATER SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	METHOD BLANKS				
	04/07/92	04/07/92	04/07/92	04/08/92	04/09/92
Chloromethane	10 U	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U	10 U
Vinyl Chloride	10 U	10 U	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	10 U	10 U
Methylene Chloride	5 J	4 J	5 J	4 J	5 J
Acetone	3 J	10 U	4 J	10 U	4 J
Carbondisulfide	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethylene	10 U	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethylene	10 U	10 U	10 U	10 U	10 U
Chloroform	10 U	10 U	10 U	10 U	10 U
1,2-Dichloroethane	10 U	10 U	10 U	10 U	10 U
Methyl Ethyl Ketone	10 U	10 U	5 J	10 U	5 J
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U	10 U
Carbon Tetrachloride	10 U	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U	10 U
1,2-Dichloropropene	10 U	10 U	10 U	10 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	10 U	10 U	10 U	10 U
Trichloroethylene	10 U	10 U	10 U	10 U	10 U
Chlorodibromomethane	10 U	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U	10 U
Methyl Isobutyl Ketone	10 U	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U	10 U
Tetrachloroethylene	10 U	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U	10 U
Ethyl Benzene	10 U	10 U	10 U	10 U	10 U
Toluene	10 U	10 U	10 U	10 U	10 U
Xylenes	10 U	10 U	10 U	10 U	10 U

U Not detected.

J Associated value is an estimate.

.037

07/21/92

TABLE 2.3 - 2 (cont.)

BLANK WATER SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	FIELD BLANKS			TRIP BLANK
	04/07/92	04/08/92	04/09/92	04/07/92
Chloromethane	10 U	10 U	10 U	10 U
Bromomethane	10 U	10 U	10 U	10 U
Vinyl Chloride	10 U	10 U	10 U	10 U
Chloroethane	10 U	10 U	10 U	10 U
Methylene Chloride	10 U	10 U	10 U	10 U
Acetone	6 J	7 J	10 U	10 U
Carbondisulfide	10 U	10 U	10 U	10 U
1,1-Dichloroethylene	10 U	10 U	10 U	10 U
1,1-Dichloroethane	10 U	10 U	10 U	10 U
1,2-Dichloroethylene	10 U	10 U	10 U	10 U
Chloroform	10 U	10 U	10 U	1 J
1,2-Dichloroethane	10 U	10 U	10 U	10 U
Methyl Ethyl Ketone	10 U	10 U	10 U	10 U
1,1,1-Trichloroethane	10 U	10 U	10 U	10 U
Carbon Tetrachloride	10 U	10 U	10 U	10 U
Bromodichloromethane	10 U	10 U	10 U	10 U
1,2-Dichloropropene	10 U	10 U	10 U	10 U
Cis-1,3-Dichloro-1-propene	10 U	10 U	10 U	10 U
Trichloroethylene	10 U	10 U	10 U	10 U
Chlorodibromomethane	10 U	10 U	10 U	10 U
1,1,2-Trichloroethane	10 U	10 U	10 U	10 U
Trans-1,3-Dichloro-1-propene	10 U	10 U	10 U	10 U
Bromoform	10 U	10 U	10 U	10 U
Methyl Isobutyl Ketone	10 U	10 U	10 U	10 U
2-Hexanone	10 U	10 U	10 U	10 U
Tetrachloroethylene	10 U	10 U	10 U	10 U
1,1,2,2-Tetrachloroethane	10 U	10 U	10 U	10 U
Chlorobenzene	10 U	10 U	10 U	10 U
Styrene	10 U	10 U	10 U	10 U
Benzene	10 U	10 U	10 U	10 U
Ethyl Benzene	10 U	10 U	10 U	10 U
Toluene	10 U	10 U	10 U	10 U
Xylenes	10 U	10 U	10 U	10 U

U Not detected.

J Associated value is an estimate.

.037

07/21/92

TABLE 2.3 - 3

BLANK SOIL SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	METHOD BLANKS				
	03/05/92	03/05/92	03/07/92	03/09/92	03/10/92
Naphthalene	330 U	330 U	330 U	330 U	330 U
2-Methylnaphthalene	330 U	330 U	330 U	330 U	330 U
Acenaphthylene	330 U	330 U	330 U	330 U	330 U
Acenaphthene	330 U	330 U	330 U	330 U	330 U
Dibenzofuran	330 U	330 U	330 U	330 U	330 U
Fluorene	330 U	330 U	330 U	330 U	330 U
Phenanthrene	330 U	330 U	330 U	330 U	330 U
Anthracene	330 U	330 U	330 U	330 U	330 U
Fluoranthene	330 U	330 U	330 U	330 U	330 U
Pyrene	330 U	330 U	330 U	330 U	330 U
Benzo(ghi)perylene	330 U	330 U	330 U	330 U	330 U
Benzo(a)anthracene	330 U	330 U	330 U	330 U	330 U
Benzo(b)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(k)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(a)pyrene	330 U	330 U	330 U	330 U	330 U
Chrysene	330 U	330 U	330 U	330 U	330 U
Dibenzo(ah)anthracene	330 U	330 U	330 U	330 U	330 U
Indeno(1,2,3,cd)pyrene	330 U	330 U	330 U	330 U	330 U
PHENOLIC COMPOUNDS					
Phenol	330 U	330 U	330 U	330 U	330 U
2-Chlorophenol	330 U	330 U	330 U	330 U	330 U
o-Cresol	330 U	330 U	330 U	330 U	330 U
p-Cresol	330 U	330 U	330 U	330 U	330 U
2-Nitrophenol	330 U	330 U	330 U	330 U	330 U
2,4-Dimethylphenol	330 U	330 U	330 U	330 U	330 U
4-Chloro-3-methylphenol	330 U	330 U	330 U	330 U	330 U
2,4,6-Trichlorophenol	330 U	330 U	330 U	330 U	330 U
2,4,5-Trichlorophenol	800 U	800 U	800 U	800 U	800 U
2,4-Dinitrophenol	800 U	800 U	800 U	800 U	800 U
4-Nitrophenol	800 U	800 U	800 U	800 U	800 U
2-Methyl-4,6-dinitrophenol	800 U	800 U	800 U	800 U	800 U
Pentachlorophenol	800 U	800 U	800 U	800 U	800 U

U Not detected.

.028

07/21/92

TABLE 2.3 - 3 (cont.)

BLANK SOIL SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/kg)

OTHER SEMI-VOLATILE COMPOUNDS	METHOD BLANKS				
	03/05/92	03/05/92	03/07/92	03/09/92	03/10/92
Bis(2-chloroethyl)ether	330 U	330 U	330 U	330 U	330 U
1,3-Dichlorobenzene	330 U	330 U	330 U	330 U	330 U
1,4-Dichlorobenzene	330 U	330 U	330 U	330 U	330 U
1,2-Dichlorobenzene	330 U	330 U	330 U	330 U	330 U
Bis(2-chloroisopropyl)ether	330 U	330 U	330 U	330 U	330 U
N-Nitrosodi-n-propylamine	330 U	330 U	330 U	330 U	330 U
Hexachloroethane	330 U	330 U	330 U	330 U	330 U
Nitrobenzene	330 U	330 U	330 U	330 U	330 U
Isophorone	330 U	330 U	330 U	330 U	330 U
Bis(2-chloroethoxy)methane	330 U	330 U	330 U	330 U	330 U
1,2,4-Trichlorobenzene	330 U	330 U	330 U	330 U	330 U
4-Chloroaniline	330 U	330 U	330 U	330 U	330 U
Hexachlorobutadiene	330 U	330 U	330 U	330 U	330 U
Hexachlorocyclopentadiene	330 U	330 U	330 U	330 U	330 U
2-Chloronaphthalene	330 U	330 U	330 U	330 U	330 U
2-Nitroaniline	800 U	800 U	800 U	800 U	800 U
Dimethyl phthalate	330 U	330 U	330 U	330 U	330 U
2,6-Dinitrotoluene	330 U	330 U	330 U	330 U	330 U
3-Nitroaniline	800 U	800 U	800 U	800 U	800 U
2,4-Dinitrotoluene	330 U	330 U	330 U	330 U	330 U
Diethyl phthalate	330 U	330 U	330 U	330 U	330 U
4-Chlorophenyl phenyl ether	330 U	330 U	330 U	330 U	330 U
4-Nitroaniline	800 U	800 U	800 U	800 U	800 U
N-Nitrosodiphenylamine	330 U	330 U	330 U	330 U	330 U
4-Bromophenyl phenyl ether	330 U	330 U	330 U	330 U	330 U
Hexachlorobenzene	330 U	330 U	330 U	330 U	330 U
Di-n-butyl phthalate	190 J	190 J	100 J	100 J	330 U
Butyl benzyl phthalate	330 U	330 U	330 U	330 U	330 U
3,3-Dichlorobenzidine	330 U	330 U	330 U	330 U	330 U
Bis(2-ethylhexyl)phthalate	96 J	96 J	330 U	330 U	330 U
Di-n-octyl phthalate	330 U	330 U	330 U	330 U	330 U
Carbazole	330 U	330 U	330 U	330 U	330 U
2,4-Dichlorophenol	330 U	330 U	330 U	330 U	330 U

U Not detected.

J Reported value is an estimate.

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07/21/92

TABLE 2.3 - 3 (cont.)

BLANK SOIL SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	METHOD BLANKS			
	03/11/92	03/13/92	03/18/92	03/25/92
Naphthalene	330 U	330 U	330 U	330 U
2-Methylnaphthalene	330 U	330 U	330 U	330 U
Acenaphthylene	330 U	330 U	330 U	330 U
Acenaphthene	330 U	330 U	330 U	330 U
Dibenzofuran	330 U	330 U	330 U	330 U
Fluorene	330 U	330 U	330 U	330 U
Phenanthrene	330 U	330 U	330 U	330 U
Anthracene	330 U	330 U	330 U	330 U
Fluoranthene	330 U	330 U	330 U	330 U
Pyrene	330 U	330 U	330 U	330 U
Benzo(ghi)perylene	330 U	330 U	330 U	330 U
Benzo(a)anthracene	330 U	330 U	330 U	330 U
Benzo(b)fluoranthene	330 U	330 U	330 U	330 U
Benzo(k)fluoranthene	330 U	330 U	330 U	330 U
Benzo(a)pyrene	330 U	330 U	330 U	330 U
Chrysene	330 U	330 U	330 U	330 U
Dibenzo(ah)anthracene	330 U	330 U	330 U	330 U
Indeno(1,2,3,cd)pyrene	330 U	330 U	330 U	330 U
PHENOLIC COMPOUNDS				
Phenol	330 U	330 U	330 U	330 U
2-Chlorophenol	330 U	330 U	330 U	330 U
o-Cresol	330 U	330 U	330 U	330 U
p-Cresol	330 U	330 U	330 U	330 U
2-Nitrophenol	330 U	330 U	330 U	330 U
2,4-Dimethylphenol	330 U	330 U	330 U	330 U
4-Chloro-3-methylphenol	330 U	330 U	330 U	330 U
2,4,6-Trichlorophenol	330 U	330 U	330 U	330 U
2,4,5-Trichlorophenol	800 U	800 U	800 U	800 U
2,4-Dinitrophenol	800 U	800 U	800 U	800 U
4-Nitrophenol	800 U	800 U	800 U	800 U
2-Methyl-4,6-dinitrophenol	800 U	800 U	800 U	800 U
Pentachlorophenol	800 U	800 U	800 U	800 U

U Not detected.				
.028				
07/21/92				

TABLE 2.3 - 3 (cont.)

BLANK SOIL SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/kg)

OTHER SEMI-VOLATILE COMPOUNDS	METHOD BLANKS			
	03/11/92	03/13/92	03/18/92	03/25/92
Bis(2-chloroethyl)ether	330 U	330 U	330 U	330 U
1,3-Dichlorobenzene	330 U	330 U	330 U	330 U
1,4-Dichlorobenzene	330 U	330 U	330 U	330 U
1,2-Dichlorobenzene	330 U	330 U	330 U	330 U
Bis(2-chloroisopropyl)ether	330 U	330 U	330 U	330 U
N-Nitrosodi-n-propylamine	330 U	330 U	330 U	330 U
Hexachloroethane	330 U	330 U	330 U	330 U
Nitrobenzene	330 U	330 U	330 U	330 U
Isophorone	330 U	330 U	330 U	330 U
Bis(2-chloroethoxy)methane	330 U	330 U	330 U	330 U
1,2,4-Trichlorobenzene	330 U	330 U	330 U	330 U
4-Chloroaniline	330 U	330 U	330 U	330 U
Hexachlorobutadiene	330 U	330 U	330 U	330 U
Hexachlorocyclopentadiene	330 U	330 U	330 U	330 U
2-Chloronaphthalene	330 U	330 U	330 U	330 U
2-Nitroaniline	800 U	800 U	800 U	800 U
Dimethyl phthalate	330 U	330 U	330 U	330 U
2,6-Dinitrotoluene	330 U	330 U	330 U	330 U
3-Nitroaniline	800 U	800 U	800 U	800 U
2,4-Dinitrotoluene	330 U	330 U	330 U	330 U
Diethyl phthalate	330 U	330 U	330 U	330 U
4-Chlorophenyl phenyl ether	330 U	330 U	330 U	330 U
4-Nitroaniline	800 U	800 U	800 U	800 U
N-Nitrosodiphenylamine	330 U	330 U	330 U	330 U
4-Bromophenyl phenyl ether	330 U	330 U	330 U	330 U
Hexachlorobenzene	330 U	330 U	330 U	330 U
Di-n-butyl phthalate	50 J	50 J	130 J	62 J
Butyl benzyl phthalate	330 U	330 U	330 U	330 U
3,3-Dichlorobenzidine	330 U	330 U	330 U	330 U
Bis(2-ethylhexyl)phthalate	330 U	330 U	330 U	330 U
Di-n-octyl phthalate	330 U	330 U	330 U	330 U
Carbazole	330 U	330 U	330 U	330 U
2,4-Dichlorophenol	330 U	330 U	330 U	330 U

U Not detected.

J Reported value is an estimate.

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07/21/92

TABLE 2.3 - 3 (cont.)

BLANK WATER SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/L)

PROJECT SPECIFIC PAH COMPOUNDS	FIELD BLANKS		METHOD BLANKS			
	04/07/92	04/09/92	04/07/92	04/08/92	04/09/92	04/09/92
Naphthalene	20 U	50 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	20 U	50 U	10 U	10 U	10 U	10 U
Acenaphthylene	20 U	50 U	10 U	10 U	10 U	10 U
Acenaphthene	20 U	50 U	10 U	10 U	10 U	10 U
Dibenzofuran	20 U	50 U	10 U	10 U	10 U	10 U
Fluorene	20 U	50 U	10 U	10 U	10 U	10 U
Phenanthrene	20 U	50 U	10 U	10 U	10 U	10 U
Anthracene	20 U	50 U	10 U	10 U	10 U	10 U
Fluoranthene	20 U	50 U	10 U	10 U	10 U	10 U
Pyrene	20 U	50 U	10 U	10 U	10 U	10 U
Benzo(ghi)perylene	20 U	50 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	20 U	50 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	20 U	50 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	20 U	50 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	20 U	50 U	10 U	10 U	10 U	10 U
Chrysene	20 U	50 U	10 U	10 U	10 U	10 U
Dibenzo(ah)anthracene	20 U	50 U	10 U	10 U	10 U	10 U
Indeno(1,2,3,cd)pyrene	20 U	50 U	10 U	10 U	10 U	10 U
PHENOLIC COMPOUNDS						
Phenol	130	310	10 U	10 U	3 J	10 U
2-Chlorophenol	20 U	50 U	10 U	10 U	10 U	10 U
o-Cresol	12 J	110	10 U	10 U	10 U	10 U
p-Cresol	33	150	10 U	10 U	10 U	10 U
2-Nitrophenol	20 U	50 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	20 U	8 J	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	20 U	50 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	20 U	50 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	50 U	120 U	25 U	25 U	25 U	25 U
2,4-Dinitrophenol	50 U	120 U	25 U	25 U	25 U	25 U
4-Nitrophenol	50 U	120 U	25 U	25 U	25 U	25 U
2-Methyl-4,6-dinitrophenol	50 U	120 U	25 U	25 U	25 U	25 U
Pentachlorophenol	50 U	120 U	25 U	25 U	25 U	25 U

U Not detected.

J Reported value is an estimate.

.028

07/21/92

TABLE 2.3 - 3 (cont.)

BLANK WATER SAMPLE DATA
SEMI-VOLATILE COMPOUNDS

(concentrations in ug/L)

OTHER SEMI-VOLATILE COMPOUNDS	FIELD BLANKS		METHOD BLANKS			
	04/07/92	04/09/92	04/07/92	04/08/92	04/09/92	04/09/92
Bis(2-chloroethyl)ether	20 U	50 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	20 U	50 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	20 U	50 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	20 U	50 U	10 U	10 U	10 U	10 U
Bis(2-chloroisopropyl)ether	20 U	50 U	10 U	10 U	10 U	10 U
N-Nitrosodi-n-propylamine	20 U	50 U	10 U	10 U	10 U	10 U
Hexachloroethane	20 U	50 U	10 U	10 U	10 U	10 U
Nitrobenzene	20 U	50 U	10 U	10 U	10 U	10 U
Isophorone	20 U	50 U	10 U	10 U	10 U	10 U
Bis(2-chloroethoxy)methane	20 U	50 U	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	20 U	50 U	10 U	10 U	10 U	10 U
4-Chloroaniline	20 U	50 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	20 U	50 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	20 U	50 U	10 U	10 U	10 U	10 U
2-Chloronaphthalene	20 U	50 U	10 U	10 U	10 U	10 U
2-Nitroaniline	50 U	120 U	25 U	25 U	25 U	25 U
Dimethyl phthalate	20 U	50 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	20 U	50 U	10 U	10 U	10 U	10 U
3-Nitroaniline	50 U	120 U	25 U	25 U	25 U	25 U
2,4-Dinitrotoluene	20 U	50 U	10 U	10 U	10 U	10 U
Diethyl phthalate	20 U	50 U	10 U	10 U	10 U	10 U
4-Chlorophenyl phenyl ether	20 U	50 U	10 U	10 U	10 U	10 U
4-Nitroaniline	50 U	120 U	25 U	25 U	25 U	25 U
N-Nitrosodiphenylamine	20 U	50 U	10 U	10 U	10 U	10 U
4-Bromophenyl phenyl ether	20 U	50 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	20 U	50 U	10 U	10 U	10 U	10 U
Di-n-butyl phthalate	20 U	50 U	4 J	4 J	1 J	12
Butyl benzyl phthalate	20 U	50 U	10 U	10 U	10 U	10 U
3,3-Dichlorobenzidine	20 U	50 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl)phthalate	20 U	50 U	10 U	10 U	10 U	10 U
Di-n-octyl phthalate	20 U	50 U	10 U	10 U	10 U	10 U
Carbazole	20 U	50 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	20 U	50 U	10 U	10 U	10 U	10 U

U Not detected.

J Reported value is an estimate.

.028

07/21/92

TABLE 2.3 - 4

BLANK SOIL SAMPLE DATA
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	METHOD BLANKS				
	03/05/92	03/10/92	03/11/92	03/13/92	03/16/92
Naphthalene	330 U	330 U	330 U	330 U	330 U
2-Methylnaphthalene	330 U	330 U	330 U	330 U	330 U
Acenaphthylene	330 U	330 U	330 U	330 U	330 U
Acenaphthene	330 U	330 U	330 U	330 U	330 U
Dibenzofuran	330 U	330 U	330 U	330 U	330 U
Fluorene	330 U	330 U	330 U	330 U	330 U
Phenanthrene	330 U	330 U	330 U	330 U	330 U
Anthracene	330 U	330 U	330 U	330 U	330 U
Fluoranthene	330 U	330 U	330 U	330 U	330 U
Pyrene	330 U	330 U	330 U	330 U	330 U
Benzo(ghi)perylene	330 U	330 U	330 U	330 U	330 U
Benzo(a)anthracene	330 U	330 U	330 U	330 U	330 U
Benzo(b)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(k)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(a)pyrene	330 U	330 U	330 U	330 U	330 U
Chrysene	330 U	330 U	330 U	330 U	330 U
Dibenzo(ah)anthracene	330 U	330 U	330 U	330 U	330 U
Indeno(1,2,3,cd)pyrene	330 U	330 U	330 U	330 U	330 U
PHENOLIC COMPOUNDS					
Phenol	330 U	--	330 U	330 U	--
2-Chlorophenol	330 U	--	330 U	330 U	--
o-Cresol	330 U	--	330 U	330 U	--
p-Cresol	330 U	--	330 U	330 U	--
2-Nitrophenol	330 U	--	330 U	330 U	--
2,4-Dimethylphenol	330 U	--	330 U	330 U	--
4-Chloro-3-methylphenol	330 U	--	330 U	330 U	--
2,4,6-Trichlorophenol	330 U	--	330 U	330 U	--
2,4,5-Trichlorophenol	800 U	--	800 U	330 U	--
2,4-Dinitrophenol	800 U	--	800 U	800 U	--
4-Nitrophenol	800 U	--	800 U	800 U	--
2-Methyl-4,6-dinitrophenol	800 U	--	800 U	800 U	--
Pentachlorophenol	800 U	--	800 U	800 U	--

-- Not analyzed.

U Not detected.

3, .002

07/21/92

TABLE 2.3 - 4 (cont.)

BLANK SOIL SAMPLE DATA
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	METHOD BLANKS				
	03/17/92	03/18/92	03/19/92	03/20/92	03/24/92
Naphthalene	330 U	330 U	330 U	330 U	330 U
2-Methylnaphthalene	330 U	330 U	330 U	330 U	330 U
Acenaphthylene	330 U	330 U	330 U	330 U	330 U
Acenaphthene	330 U	330 U	330 U	330 U	330 U
Dibenzofuran	330 U	330 U	330 U	330 U	330 U
Fluorene	330 U	330 U	330 U	330 U	330 U
Phenanthrene	330 U	330 U	330 U	330 U	330 U
Anthracene	330 U	330 U	330 U	330 U	330 U
Fluoranthene	330 U	330 U	330 U	330 U	330 U
Pyrene	330 U	330 U	330 U	330 U	330 U
Benzo(ghi)perylene	330 U	330 U	330 U	330 U	330 U
Benzo(a)anthracene	330 U	330 U	330 U	330 U	330 U
Benzo(b)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(k)fluoranthene	330 U	330 U	330 U	330 U	330 U
Benzo(a)pyrene	330 U	330 U	330 U	330 U	330 U
Chrysene	330 U	330 U	330 U	330 U	330 U
Dibenzo(ah)anthracene	330 U	330 U	330 U	330 U	330 U
Indeno(1,2,3,cd)pyrene	330 U	330 U	330 U	330 U	330 U
PHENOLIC COMPOUNDS					
Phenol	--	330 U	330 U	330 U	330 U
2-Chlorophenol	--	330 U	330 U	330 U	330 U
o-Cresol	--	330 U	330 U	330 U	330 U
p-Cresol	--	330 U	330 U	330 U	330 U
2-Nitrophenol	--	330 U	330 U	330 U	330 U
2,4-Dimethylphenol	--	330 U	330 U	330 U	330 U
4-Chloro-3-methylphenol	--	330 U	330 U	330 U	330 U
2,4,6-Trichlorophenol	--	330 U	330 U	330 U	330 U
2,4,5-Trichlorophenol	--	800 U	800 U	800 U	800 U
2,4-Dinitrophenol	--	800 U	800 U	800 U	800 U
4-Nitrophenol	--	800 U	800 U	800 U	800 U
2-Methyl-4,6-dinitrophenol	--	800 U	800 U	800 U	800 U
Pentachlorophenol	--	800 U	800 U	800 U	800 U

--	Not analyzed.				
U	Not detected.				
3, .002					
07/21/92					

TABLE 2.3 - 5

BLANK SOIL SAMPLE DATA
PESTICIDES AND PCBS

(concentrations in ug/kg)

	METHOD BLANKS							
	03/05/92	03/07/92	03/09/92	03/10/92	03/11/92	03/13/92	03/18/92	03/25/92
a-BHC	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
b-BHC	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
d-BHC	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
g-BHC (Lindane)	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Heptachlor	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Aldrin	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Heptachlor Epoxide	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Endosulfan I	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Dieldrin	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDE	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Endrin	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Endosulfan II	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDD	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Endosulfan Sulfate	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDT	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Methoxychlor	17 U	17 U	17 U	17 U	17 U	17 U	17 U	17 U
Endrin Ketone	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
Endrin Aldehyde	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U	3.3 U
cis-Chlordane	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
trans-Chlordane	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U	1.7 U
Toxaphene	170 U	170 U	170 U	170 U	170 U	170 U	170 U	170 U
PCB-1016	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PCB-1221	67 U	67 U	67 U	67 U	67 U	67 U	67 U	67 U
PCB-1232	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PCB-1242	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PCB-1248	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PCB-1254	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U
PCB-1260	33 U	33 U	33 U	33 U	33 U	33 U	33 U	33 U

U Not detected.

.043

07/21/92

TABLE 2.3 - 5 (cont.)

BLANK WATER SAMPLE DATA
PESTICIDES AND PCBS

(concentrations in ug/L)

	FIELD BLANKS		METHOD BLANKS		
	04/07/92	04/09/92	04/07/92	04/08/92	04/09/92
a-BHC	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
b-BHC	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
d-BHC	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
g-BHC (Lindane)	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Heptachlor	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Aldrin	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Heptachlor Epoxide	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Endosulfan I	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Dieldrin	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4,4'-DDE	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Endrin	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Endosulfan II	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4,4'-DDD	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Endosulfan Sulfate	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
4,4'-DDT	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Methyloxychlor	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Endrin Ketone	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Endrin Aldehyde	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
cis-Chlordane	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
trans-Chlordane	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Toxaphene	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
PCB-1016	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCB-1221	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
PCB-1232	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCB-1242	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCB-1248	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCB-1254	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
PCB-1260	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U

U Not detected.

.043

07/21/92

TABLE 2.3 - 6

BLIND DUPLICATE SOIL SAMPLE DATA
INORGANICS

(concentrations in mg/kg)

	BS06		RPD	SS02		RPD
	03/25/92	03/25/92		03/06/92	03/06/92	
	SAMPLE	DUPLICATE		SAMPLE	DUPLICATE	
Aluminum	1670	3550	73	1550	892	53
Antimony	2.9 BJ	2.3 UJ	86	2.7 UJ	2.7 UJ	
Arsenic	1.7 BJ	1.7 BJ	0	1.1 U	0.91 U	
Barium	8.8 BJ	12.2 BJ	98	8.3 BJ	5.5 BJ	40
Beryllium	0.20 UJ	0.29 BJ		0.23 UJ	0.11 UJ	
Cadmium	0.62 U	0.62 U		0.73 U	0.72 U	
Calcium	27800	27300	1	18600	21300	14
Chromium, total	5.3	8.5	47	4.3	4.0 U	73
Cobalt	2.9 B	5.8 B	67	1.7 B	1.8 B	6
Copper	8.3	24.3	99	5.4 B	4.6 B	16
Iron	5380	10100	61	2590	2350	9
Lead	3.5 J	3.1 J	12	2.5 J	3.0 J	19
Magnesium	14600	16000	10	8990	10900	20
Manganese	194	249	25	85.5	88.8	4
Mercury	0.07 UJ	0.08 UJ		0.08 U	0.08 U	
Nickel	5.3 B	12.8	83	4.1 U	3.6 U	
Potassium	151 U	365 B	132	263 UJ	210 UJ	
Selenium	0.27 U	0.27 U		0.32 U	0.32 U	
Silver	0.37 U	0.37 U		0.52 U	0.42 U	
Sodium	204 UJ	326 UJ		377 UJ	321 UJ	
Thallium	0.35 U	0.35 U		0.41 U	0.41 U	
Vanadium	14.9	32.9	76	5.7 B	4.4 B	25
Zinc	21.2 J	40.8 J	64	20.3	17.7	13
Cyanide	0.79 BJ	1.2 BJ	42	--	--	

	TT1001		RPD
	03/21/92	03/21/92	
	SAMPLE	DUPLICATE	
Aluminum	--	--	
Antimony	--	--	
Arsenic	191	318	50
Barium	--	--	
Beryllium	--	--	
Cadmium	--	--	
Calcium	--	--	
Chromium, total	--	--	
Cobalt	--	--	
Copper	--	--	
Iron	--	--	
Lead	--	--	
Magnesium	--	--	
Manganese	--	--	
Mercury	--	--	
Nickel	--	--	
Potassium	--	--	
Selenium	--	--	
Silver	--	--	
Sodium	--	--	
Thallium	--	--	
Vanadium	--	--	
Zinc	--	--	
Cyanide	1.3 BJ	2.5 BJ	64

-- Not analyzed.

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

RPD Relative Percent Difference

3, .007

07/21/92

TABLE 2.3 - 6 (cont.)

BLIND DUPLICATE WATER SAMPLE DATA
INORGANICS

(concentrations in mg/L)

	MW4D1		RPD	MW6S1		RPD
	04/07/92 SAMPLE	04/07/92 DUPLICATE		04/08/92 SAMPLE	04/08/92 DUPLICATE	
Aluminum	135 U	128 U		19.0 U	40.7 U	
Antimony	10.9 UJ	10.9 UJ		10.9 UJ	10.9 UJ	
Arsenic	22400	27100	19	350	387	11
Barium	402	448	11	153 BJ	148 BJ	3
Beryllium	0.19 UJ	0.19 UJ		0.19 UJ	0.22 UJ	
Cadmium	50.7 J	50.3 J	0	4.3 BJ	2.9 UJ	99
Calcium	37200	39300	6	154000	142000	8
Chromium, total	15.4 J	17.1 J	11	2.1 UJ	2.1 UJ	
Cobalt	15.2 B	16.6 B	9	3.6 U	3.6 U	
Copper	43.8	91.0	71	12.6 U	12.6 U	
Iron	807	975	19	305 J	241 UJ	86
Lead	4.1 J	2.2 BJ	60	1.1 B	3.2	98
Magnesium	20000	22400	12	41700	37900	9
Manganese	326	387	18	491	442	10
Mercury	0.0010 U	0.0010 U		0.0010 U	0.0010 U	
Nickel	46.7	82.2	56	3.8 U	3.8 U	
Potassium	30000	34900	16	2170 B	2370 B	9
Selenium	6.0 UJ	6.8 BJ	78	2.9 BJ	2.0 BJ	36
Silver	1.7 U	1.7 U		1.7 U	1.7 U	
Sodium	170000	181000	7	8230 J	7920 J	3
Thallium	1.7 UJ	1.7 UJ		1.7 U	1.7 U	
Vanadium	33.1 B	37.0 B	12	3.2 B	4.1 B	25
Zinc	72.0 UJ	84.2 UJ		19.1 U	27.9 U	
Cyanide	706	662	6	12.2	17.1	34

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

RPD Relative Percent Difference

3,.007

07/21/92

TABLE 2.3 - 7

BLIND DUPLICATE SOIL SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	BS06		RPD	TT1501		RPD
	03/25/92 SAMPLE	03/25/92 DUPLICATE		03/17/92 SAMPLE	03/17/92 DUPLICATE	
Chloromethane	11 U	11 U		12 U	12 U	
Bromomethane	11 U	11 U		12 U	12 U	
Vinyl Chloride	11 U	11 U		12 U	12 U	
Chloroethane	11 U	11 U		12 U	12 U	
Methylene Chloride	11 U	11 U		16 U	22 U	
Acetone	11 U	11 U		23 U	87 U	
Carbondisulfide	11 U	11 U		12 U	1 J	142
1,1-Dichloroethylene	11 U	11 U		12 U	12 U	
1,1-Dichloroethane	11 U	11 U		12 U	12 U	
1,2-Dichloroethylene	11 U	11 U		12 U	12 U	
Chloroform	11 U	11 U		12 U	12 U	
1,2-Dichloroethane	11 U	11 U		12 U	12 U	
Methyl Ethyl Ketone	11 U	11 U		12 U	40	148
1,1,1-Trichloroethane	11 U	11 U		12 U	12 U	
Carbon Tetrachloride	11 U	11 U		12 U	12 U	
Bromodichloromethane	11 U	11 U		12 U	12 U	
1,2-Dichloropropane	11 U	11 U		12 U	12 U	
Cis-1,3-Dichloro-1-propene	11 U	11 U		12 U	12 U	
Trichloroethylene	11 U	11 U		12 U	12 U	
Chlorodibromomethane	11 U	11 U		12 U	12 U	
1,1,2-Trichloroethane	11 U	11 U		12 U	12 U	
Trans-1,3-Dichloro-1-propene	11 U	11 U		12 U	12 U	
Bromoform	11 U	11 U		12 U	12 U	
Methyl Isobutyl Ketone	11 U	11 U		12 U	12 U	
2-Hexanone	11 U	11 U		12 U	12 U	
Tetrachloroethylene	11 U	11 U		12 U	12 U	
1,1,2,2-Tetrachloroethane	11 U	11 U		12 U	12 U	
Chlorobenzene	11 U	11 U		12 U	12 U	
Styrene	11 U	11 U		12 U	12 U	
Benzene	2 J	11 U	94	12 U	1 J	142
Ethyl Benzene	11 U	11 U		12 U	12 U	
Toluene	3 J	11 U	59	12 U	2 J	100
Xylenes	4 J	1 J	120	12 U	6 J	0

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

RPD Relative Percent Difference

3,.003

08/20/92

TABLE 2.3 - 7 (cont.)

BLIND DUPLICATE SOIL SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

	TT2201		RPD
	03/12/92	03/12/92	
	SAMPLE	DUPLICATE	
Chloromethane	14 U	14 U	
Bromomethane	14 U	14 U	
Vinyl Chloride	14 U	14 U	
Chloroethane	14 U	14 U	
Methylene Chloride	42	83	66
Acetone	42 U	98	130
Carbondisulfide	6 J	10 J	50
1,1-Dichloroethylene	14 U	14 U	
1,1-Dichloroethane	14 U	14 U	
1,2-Dichloroethylene	14 U	14 U	
Chloroform	14 U	14 U	
1,2-Dichloroethane	14 U	14 U	
Methyl Ethyl Ketone	21	42	67
1,1,1-Trichloroethane	14 U	6 J	15
Carbon Tetrachloride	14 U	14 U	
Bromodichloromethane	14 U	14 U	
1,2-Dichloropropane	14 U	14 U	
Cis-1,3-Dichloro-1-propene	14 U	14 U	
Trichloroethylene	14 U	14 U	
Chlorodibromomethane	14 U	14 U	
1,1,2-Trichloroethane	14 U	14 U	
Trans-1,3-Dichloro-1-propene	14 U	14 U	
Bromoform	14 U	14 U	
Methyl Isobutyl Ketone	14 U	14 U	
2-Hexanone	14 U	14 U	
Tetrachloroethylene	14 U	14 U	
1,1,2,2-Tetrachloroethane	14 U	14 U	
Chlorobenzene	14 U	14 U	
Styrene	14 U	14 U	
Benzene	14 U	14 U	
Ethyl Benzene	14 U	14 U	
Toluene	14 U	14 U	
Xylenes	14 U	14 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

RPD Relative Percent Difference

3,.003

08/20/92

TABLE 2.3 - 7 (cont.)

BLIND DUPLICATE WATER SAMPLE DATA
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MW4D1		RPD	MW6S1		RPD
	04/07/92 SAMPLE	04/07/92 DUPLICATE		04/08/92 SAMPLE	04/08/92 DUPLICATE	
Chloromethane	40 U	40 U		10 U	10 U	
Bromomethane	40 U	40 U		10 U	10 U	
Vinyl Chloride	40 U	40 U		10 U	10 U	
Chloroethane	40 U	40 U		10 U	10 U	
Methylene Chloride	40 U	40 U		10 U	10 U	
Acetone	860	820	4	11 U	10 U	
Carbondisulfide	6 J	6 J	0	10 U	10 U	
1,1-Dichloroethylene	40 U	40 U		10 U	10 U	
1,1-Dichloroethane	40 U	40 U		10 U	10 U	
1,2-Dichloroethylene	40 U	40 U		10 U	10 U	
Chloroform	40 U	40 U		10 U	10 U	
1,2-Dichloroethane	40 U	40 U		10 U	10 U	
Methyl Ethyl Ketone	140	140	0	10 U	10 U	
1,1,1-Trichloroethane	40 U	40 U		10 U	10 U	
Carbon Tetrachloride	40 U	40 U		10 U	10 U	
Bromodichloromethane	40 U	40 U		10 U	10 U	
1,2-Dichloropropane	40 U	40 U		10 U	10 U	
Cis-1,3-Dichloro-1-propene	40 U	40 U		10 U	10 U	
Trichloroethylene	40 U	40 U		10 U	10 U	
Chlorodibromomethane	40 U	40 U		10 U	10 U	
1,1,2-Trichloroethane	40 U	40 U		10 U	10 U	
Trans-1,3-Dichloro-1-propene	40 U	40 U		10 U	10 U	
Bromoform	40 U	40 U		10 U	10 U	
Methyl Isobutyl Ketone	40 U	40 U		10 U	10 U	
2-Hexanone	40 U	40 U		10 U	10 U	
Tetrachloroethylene	40 U	40 U		10 U	10 U	
1,1,2,2-Tetrachloroethane	40 U	40 U		10 U	10 U	
Chlorobenzene	40 U	40 U		10 U	10 U	
Styrene	40 U	40 U		7 J	8 J	14
Benzene	460	420	9	44	50	13
Ethyl Benzene	40 U	40 U		69	78	13
Toluene	40 U	40 U		23	25	9
Xylenes	40 U	40 U		100	120	19

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

RPD Relative Percent Difference

3, .003

08/20/92

TABLE 2.3 - 8

BLIND DUPLICATE SOIL SAMPLE DATA
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	BS06		RPD	SS02		RPD
	03/25/92 SAMPLE	03/25/92 DUPLICATE		03/06/92 SAMPLE	03/06/92 DUPLICATE	
Naphthalene	350 U	350 U		390 U	390 U	
2-Methylnaphthalene	350 U	350 U		390 U	390 U	
Acenaphthylene	350 U	350 U		390 U	390 U	
Acenaphthene	350 U	350 U		390 U	390 U	
Dibenzofuran	350 U	350 U		390 U	390 U	
Fluorene	350 U	350 U		390 U	390 U	
Phenanthrene	350 U	350 U		170 J	59 J	96
Anthracene	350 U	350 U		220 J	390 U	12
Fluoranthene	350 U	350 U		320 J	150 J	72
Pyrene	350 U	350 U		240 J	120 J	66
Benzo(ghi)perylene	89 J	350 U	66	62 J	41 J	40
Benzo(a)anthracene	350 U	350 U		96 J	69 J	32
Benzo(b)fluoranthene	350 U	350 U		100 J	74 J	29
Benzo(k)fluoranthene	350 U	350 U		150 J	90 J	50
Benzo(a)pyrene	350 U	350 U		82 J	49 J	50
Chrysene	350 U	350 U		180 J	99 J	58
Dibenzo(ah)anthracene	350 U	350 U		390 U	390 U	
Indeno(1,2,3,cd)pyrene	350 U	350 U		83 J	56 J	38
PHENOLIC COMPOUNDS						
Phenol	350 UJ	350 UJ		390 U	390 U	
2-Chlorophenol	350 U	350 U		390 U	390 U	
o-Cresol	350 U	350 U		390 U	390 U	
p-Cresol	350 U	350 U		390 U	390 U	
2-Nitrophenol	350 U	350 U		390 U	390 U	
2,4-Dimethylphenol	350 U	350 U		390 U	390 U	
4-Chloro-3-methylphenol	350 U	350 U		390 U	390 U	
2,4,6-Trichlorophenol	350 U	350 U		390 U	390 U	
2,4,5-Trichlorophenol	840 U	850 U		950 U	940 U	
2,4-Dinitrophenol	840 U	850 U		950 U	940 U	
4-Nitrophenol	840 U	850 U		950 U	940 U	
2-Methyl-4,6-dinitrophenol	840 U	850 U		950 U	940 U	
Pentachlorophenol	840 U	850 U		950 U	940 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

RPD Relative Percent Difference

3, .004

08/20/92

TABLE 2.3 - 8 (cont.)

BLIND DUPLICATE SOIL SAMPLE DATA
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/kg)

OTHER SEMI-VOLATILE COMPOUNDS	BS06		RPD	SS02		RPD
	03/25/92 SAMPLE	03/25/92 DUPLICATE		03/06/92 SAMPLE	03/06/92 DUPLICATE	
Bis(2-chloroethyl)ether	350 U	350 U		390 U	390 U	
1,3-Dichlorobenzene	350 U	350 U		390 U	390 U	
1,4-Dichlorobenzene	350 U	350 U		390 U	390 U	
1,2-Dichlorobenzene	350 U	350 U		390 U	390 U	
Bis(2-chloroisopropyl)ether	350 U	350 U		390 U	390 U	
N-Nitrosodi-n-propylamine	350 U	350 U		390 U	390 U	
Hexachloroethane	350 U	350 U		390 U	390 U	
Nitrobenzene	350 U	350 U		390 U	390 U	
Isophorone	350 U	350 U		390 U	390 U	
Bis(2-chloroethoxy)methane	350 U	350 U		390 U	390 U	
1,2,4-Trichlorobenzene	350 U	350 U		390 U	390 U	
4-Chloroaniline	350 U	350 U		390 U	390 U	
Hexachlorobutadiene	350 U	350 U		390 U	390 U	
Hexachlorocyclopentadiene	350 U	350 U		390 U	390 U	
2-Chloronaphthalene	350 U	350 U		390 U	390 U	
2-Nitroaniline	840 U	850 U		950 U	940 U	
Dimethyl phthalate	350 U	350 U		390 U	390 U	
2,6-Dinitrotoluene	350 U	350 U		390 U	390 U	
3-Nitroaniline	840 U	850 U		950 U	940 U	
2,4-Dinitrotoluene	350 U	350 U		390 U	390 U	
Diethyl phthalate	350 U	350 U		390 U	390 U	
4-Chlorophenyl phenyl ether	350 U	350 U		390 U	390 U	
4-Nitroaniline	840 U	850 U		950 U	940 U	
N-Nitrosodiphenylamine	350 U	350 U		390 U	390 U	
4-Bromophenyl phenyl ether	350 U	350 U		390 U	390 U	
Hexachlorobenzene	350 U	350 U		390 U	390 U	
Di-n-butyl phthalate	350 U	350 U		390 U	390 U	
Butyl benzyl phthalate	350 U	350 U		390 U	210 J	8
3,3-Dichlorobenzidine	350 U	350 U		390 U	390 U	
Bis(2-ethylhexyl)phthalate	350 U	350 U		390 U	390 U	
Di-n-octyl phthalate	350 U	350 U		390 U	390 U	
Carbazole	350 U	350 U		110 J	390 U	56
2,4-Dichlorophenol	350 U	350 U		390 U	390 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

RPD Relative Percent Difference

3,.004

08/20/92

TABLE 2.3 - 8 (cont.)

BLIND DUPLICATE WATER SAMPLE DATA
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

PROJECT SPECIFIC PAH COMPOUNDS	MW4D1		RPD	MW6S1		RPD
	04/07/92 SAMPLE	04/07/92 DUPLICATE		04/08/92 SAMPLE	04/08/92 DUPLICATE	
Naphthalene	200000 U	50000 U		1800	1100	48
2-Methylnaphthalene	200000 U	50000 U		20 J	17 J	16
Acenaphthylene	200000 U	50000 U		150 U	150 U	
Acenaphthene	200000 U	50000 U		150	150	0
Dibenzofuran	200000 U	50000 U		48 J	49 J	3
Fluorene	200000 U	50000 U		19 J	20 J	6
Phenanthrene	200000 U	50000 U		150 U	150 U	
Anthracene	200000 U	50000 U		150 U	150 U	
Fluoranthene	200000 U	50000 U		150 U	150 U	
Pyrene	200000 U	50000 U		150 U	150 U	
Benzo(ghi)perylene	200000 U	50000 U		150 U	150 U	
Benzo(a)anthracene	200000 U	50000 U		150 U	150 U	
Benzo(b)fluoranthene	200000 U	50000 U		150 U	150 U	
Benzo(k)fluoranthene	200000 U	50000 U		150 U	150 U	
Benzo(a)pyrene	200000 U	50000 U		150 U	150 U	
Chrysene	200000 U	50000 U		150 U	150 U	
Dibenzo(ah)anthracene	200000 U	50000 U		150 U	150 U	
Indeno(1,2,3,cd)pyrene	200000 U	50000 U		150 U	150 U	
PHENOLIC COMPOUNDS						
Phenol	1500000	320000	73	340	340	0
2-Chlorophenol	200000 U	50000 U		150 U	150 U	
o-Cresol	170000 J	34000 J	133	67 J	72 J	8
p-Cresol	710000	150000	130	110 J	110 J	0
2-Nitrophenol	200000 U	50000 U		150 U	150 U	
2,4-Dimethylphenol	41000 J	7600 J	137	46 J	36 J	24
4-Chloro-3-methylphenol	200000 U	50000 U		150 U	150 U	
2,4,6-Trichlorophenol	200000 U	50000 U		150 U	150 U	
2,4,5-Trichlorophenol	500000 U	120000 U		380 U	380 U	
2,4-Dinitrophenol	500000 U	120000 U		380 U	380 U	
4-Nitrophenol	500000 U	120000 U		380 U	380 U	
2-Methyl-4,6-dinitrophenol	500000 U	120000 U		380 U	380 U	
Pentachlorophenol	500000 U	120000 U		380 U	380 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

RPD Relative Percent Difference

3, .004

08/20/92

TABLE 2.3 - 8 (cont.)

BLIND DUPLICATE WATER SAMPLE DATA
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	MW401		RPD	MW6S1		RPD
	04/07/92 SAMPLE	04/07/92 DUPLICATE		04/08/92 SAMPLE	04/08/92 DUPLICATE	
OTHER SEMI-VOLATILE COMPOUNDS						
Bis(2-chloroethyl)ether	200000 U	50000 U		150 U	150 U	
1,3-Dichlorobenzene	200000 U	50000 U		150 U	150 U	
1,4-Dichlorobenzene	200000 U	50000 U		150 U	150 U	
1,2-Dichlorobenzene	200000 U	50000 U		150 U	150 U	
Bis(2-chloroisopropyl)ether	200000 U	50000 U		150 U	150 U	
N-Nitrosodi-n-propylamine	200000 U	50000 U		150 U	150 U	
Hexachloroethane	200000 U	50000 U		150 U	150 U	
Nitrobenzene	200000 U	50000 U		150 U	150 U	
Isophorone	200000 U	50000 U		150 U	150 U	
Bis(2-chloroethoxy)methane	200000 U	50000 U		150 U	150 U	
1,2,4-Trichlorobenzene	200000 U	50000 U		150 U	150 U	
4-Chloroaniline	200000 U	50000 U		150 U	150 U	
Hexachlorobutadiene	200000 U	50000 U		150 U	150 U	
Hexachlorocyclopentadiene	200000 U	50000 U		150 U	150 U	
2-Chloronaphthalene	200000 U	50000 U		150 U	150 U	
2-Nitroaniline	500000 U	120000 U		380 U	380 U	
Dimethyl phthalate	200000 U	50000 U		150 U	150 U	
2,6-Dinitrotoluene	200000 U	50000 U		150 U	150 U	
3-Nitroaniline	500000 U	120000 U		380 U	380 U	
2,4-Dinitrotoluene	200000 U	50000 U		150 U	150 U	
Diethyl phthalate	200000 U	50000 U		150 U	150 U	
4-Chlorophenyl phenyl ether	200000 U	50000 U		150 U	150 U	
4-Nitroaniline	500000 U	120000 U		380 U	380 U	
N-Nitrosodiphenylamine	200000 U	50000 U		150 U	150 U	
4-Bromophenyl phenyl ether	200000 U	50000 U		150 U	150 U	
Hexachlorobenzene	200000 U	50000 U		150 U	150 U	
Di-n-butyl phthalate	200000 U	50000 U		150 U	150 U	
Butyl benzyl phthalate	200000 U	50000 U		150 U	150 U	
3,3-Dichlorobenzidine	200000 U	50000 U		150 U	150 U	
Bis(2-ethylhexyl)phthalate	200000 U	50000 U		150 U	150 U	
Di-n-octyl phthalate	200000 U	50000 U		150 U	150 U	
Carbazole	200000 U	50000 U		110 J	95 J	14
2,4-Dichlorophenol	200000 U	50000 U		150 U	150 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

RPD Relative Percent Difference

3, .004

08/20/92

TABLE 2.3 - 9

BLIND DUPLICATE SOIL SAMPLE DATA
PAH AND PHENOLIC COMPOUNDS

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	TT0102		RPD	TT1001		RPD
	03/06/92 SAMPLE	03/06/92 DUPLICATE		03/21/92 SAMPLE	03/21/92 DUPLICATE	
Naphthalene	190000	660000	96	610000	720000	17
2-Methylnaphthalene	300000	120000	85	120000 J	110000 J	8
Acenaphthylene	47000 J	25000 J	61	65000 J	31000 J	70
Acenaphthene	11000 J	4700 J	80	120000 U	140000 U	
Dibenzofuran	58000 J	27000 J	72	17000 J	16000 J	6
Fluorene	96000	42000	78	27000 J	25000 J	7
Phenanthrene	120000	60000	66	23000 J	16000 J	35
Anthracene	32000 J	16000 J	66	120000 U	140000 U	
Fluoranthene	57000 J	32000	56	120000 U	140000 U	
Pyrene	39000 J	22000 J	55	120000 U	140000 U	
Benzo(ghi)perylene	80000 U	4000 J	180	120000 U	140000 U	
Benzo(a)anthracene	26000 J	12000 J	73	120000 U	140000 U	
Benzo(b)fluoranthene	18000 J	9900 J	58	120000 U	140000 U	
Benzo(k)fluoranthene	19000 J	11000 J	53	120000 U	140000 U	
Benzo(a)pyrene	18000 J	10000 J	57	120000 U	140000 U	
Chrysene	29000 J	15000 J	63	120000 U	140000 U	
Dibenzo(ah)anthracene	80000 U	31000 U		120000 U	140000 U	
Indeno(1,2,3,cd)pyrene	9500 J	5600 J	51	120000 U	140000 U	
PHENOLIC COMPOUNDS						
Phenol	80000 U	31000 U		120000 U	140000 U	
2-Chlorophenol	80000 U	31000 U		120000 U	140000 U	
o-Cresol	80000 U	31000 U		120000 U	140000 U	
p-Cresol	80000 U	31000 U		120000 U	140000 U	
2-Nitrophenol	80000 U	31000 U		120000 U	140000 U	
2,4-Dimethylphenol	80000 U	31000 U		120000 U	140000 U	
4-Chloro-3-methylphenol	80000 U	31000 U		120000 U	140000 U	
2,4,6-Trichlorophenol	80000 U	31000 U		120000 U	140000 U	
2,4,5-Trichlorophenol	190000 U	75000 U		300000 U	340000 U	
2,4-Dinitrophenol	190000 U	75000 U		300000 U	340000 U	
4-Nitrophenol	190000 U	75000 U		300000 U	340000 U	
2-Methyl-4,6-dinitrophenol	190000 U	75000 U		300000 U	340000 U	
Pentachlorophenol	190000 U	75000 U		300000 U	340000 U	

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

RPD Relative Percent Difference

3, .004

08/20/92

TABLE 2.3 - 10

BLIND DUPLICATE SOIL SAMPLE DATA
PESTICIDE AND PCB COMPOUNDS

(concentrations in ug/kg)

	BS06		RPD	SS02		RPD
	03/25/92 SAMPLE	03/25/92 DUPLICATE		03/06/92 SAMPLE	03/06/92 DUPLICATE	
a-BHC	1.8 U	1.8 U		2.0 U	2.0 U	
b-BHC	1.8 U	1.8 U		2.0 U	2.0 U	
d-BHC	1.8 U	1.8 U		2.0 U	2.0 U	
g-BHC (Lindane)	1.8 U	1.8 U		2.0 U	2.0 U	
Heptachlor	2.5	2.0	22	2.0 U	2.0 U	
Aldrin	1.8 U	1.8 U		2.0 U	2.0 U	
Heptachlor Epoxide	5.5 P	6.9 P	23	2.0 U	2.0 U	
Endosulfan I	1.8 U	1.8 U		2.0 U	2.0 U	
Dieldrin	3.5 U	3.5 U		3.9 U	3.9 U	
4,4'-DDE	3.5 U	3.5 U		3.9 U	3.9 U	
Endrin	3.5 U	3.5 U		3.9 U	3.9 U	
Endosulfan II	3.5 U	3.5 U		3.9 U	3.9 U	
4,4'-DDD	3.5 U	3.5 U		3.9 U	3.9 U	
Endosulfan Sulfate	3.5 U	3.5 U		3.9 U	3.9 U	
4,4'-DDT	3.5 U	3.5 U		3.9 U	3.9 U	
Methoxychlor	18 U	18 U		20 U	20 U	
Endrin Ketone	3.5 U	3.5 U		3.9 U	3.9 U	
Endrin Aldehyde	3.5 U	3.5 U		3.9 U	3.9 U	
cis-Chlordane	28	31	11	2.0 U	2.0 U	
trans-Chlordane	16	18	12	2.0 U	2.0 U	
Toxaphene	180 U	180 U		200 U	200 U	
PCB-1016	35 U	35 U		39 U	39 U	
PCB-1221	71 U	71 U		80 U	79 U	
PCB-1232	35 U	35 U		39 U	39 U	
PCB-1242	35 U	35 U		39 U	39 U	
PCB-1248	35 U	35 U		39 U	39 U	
PCB-1254	35 U	35 U		39 U	39 U	
PCB-1260	35 U	35 U		39 U	39 U	

U Not detected.

P Greater than 25 percent difference for detected concentrations between primary and confirmation GC columns. Result reported is the lower of the two values.

RPD Relative Percent Difference

3,.006

07/21/92

TABLE 2.3 - 10 (cont.)

BLIND DUPLICATE WATER SAMPLE DATA
PESTICIDE AND PCB COMPOUNDS

(concentrations in ug/L)

	MM4D1		RPD	MM6S1		RPD
	04/07/92	04/07/92		04/08/92	04/08/92	
	SAMPLE	DUPLICATE		SAMPLE	DUPLICATE	
a-BHC	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
b-BHC	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
d-BHC	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
g-BHC (Lindane)	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Heptachlor	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Aldrin	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Heptachlor Epoxide	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Endosulfan I	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Dieldrin	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
4,4'-DDE	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
Endrin	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
Endosulfan II	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
4,4'-DDD	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
Endosulfan Sulfate	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
4,4'-DDT	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
Methyloxychlor	0.50 U	0.50 U		0.50 UJ	0.50 UJ	
Endrin Ketone	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
Endrin Aldehyde	0.10 U	0.10 U		0.10 UJ	0.10 UJ	
cis-Chlordane	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
trans-Chlordane	0.050 U	0.050 U		0.050 UJ	0.050 UJ	
Toxaphene	5.0 U	5.0 U		5.0 UJ	5.0 UJ	
PCB-1016	5.0 U	5.0 U		2.0 UJ	2.0 UJ	
PCB-1221	10 U	10 U		4.0 UJ	4.0 UJ	
PCB-1232	5.0 U	5.0 U		2.0 UJ	2.0 UJ	
PCB-1242	5.0 U	5.0 U		2.0 UJ	2.0 UJ	
PCB-1248	5.0 U	5.0 U		2.0 UJ	2.0 UJ	
PCB-1254	5.0 U	5.0 U		2.0 UJ	2.0 UJ	
PCB-1260	5.0 U	5.0 U		2.0 UJ	2.0 UJ	

U Not detected.

J Associated value is an estimate.

RPD Relative Percent Difference

3,.006

07/21/92

TABLE 2.3 - 11

BLIND DUPLICATE SOIL SAMPLE DATA
TCLP ANALYSIS

(concentrations in ug/L)

	TT0604		RPD
	03/09/92 SAMPLE	03/09/92 DUPLICATE	
Vinyl Chloride, TCLP	50 U	50 U	
1,1-Dichloroethene, TCLP	25 U	25 U	
Chloroform, TCLP	25 U	25 U	
1,2-Dichloroethane, TCLP	25 U	25 U	
2-Butanone, TCLP	50 U	50 U	
Carbon Tetrachloride, TCLP	25 U	25 U	
Trichloroethene, TCLP	25 U	25 U	
Benzene, TCLP	25 U	25 U	
Tetrachloroethene, TCLP	25 U	25 U	
Chlorobenzene, TCLP	25 U	25 U	
1,4-Dichlorobenzene, TCLP	50 U	50 U	
o-Cresol, TCLP	50 U	50 U	
m-Cresol, TCLP	50 U	50 U	
p-Cresol, TCLP	50 U	50 U	
Hexachloroethane, TCLP	50 U	50 U	
Nitrobenzene, TCLP	50 U	50 U	
Hexachlorobutadiene, TCLP	50 U	50 U	
2,4,6-Trichlorophenol, TCLP	50 U	50 U	
2,4,5-Trichlorophenol, TCLP	250 U	250 U	
2,4-Dinitrotoluene, TCLP	50 U	50 U	
Hexachlorobenzene, TCLP	50 U	50 U	
Pentachlorophenol, TCLP	250 U	250 U	
Pyridine, TCLP	250 U	250 U	
g-BHC (Lindane), TCLP	2 U	2 U	
Heptachlor, TCLP	2 U	2 U	
Heptachlor Epoxide, TCLP	2 U	2 U	
Endrin, TCLP	2 U	2 U	
Methyloxychlor, TCLP	10 U	10 U	
Chlordane, TCLP	10 U	10 U	
Toxaphene, TCLP	50 U	50 U	
2,4-D, TCLP	100 U	100 U	
2,4,5-TP (Silvex), TCLP	10 U	10 U	
Silver, TCLP	10.0 U	10.0 U	
Arsenic, TCLP	30.0 U	30.0 U	
Barium, TCLP	832	876	6
Cadmium, TCLP	5.0 U	6.3	87
Chromium, TCLP	10.0 U	10.0 U	
Mercury, TCLP	0.2 U	0.2 U	
Lead, TCLP	30.0 U	30.0 U	
Selenium, TCLP	60.0 U	60.0 U	

U Not detected.

RPD Relative Percent Difference

.031

07/23/92

TABLE 2.4-1

VERTICAL HYDRAULIC GRADIENTS

DATE	MW-1S/MW-1D	MW-3S/MW-3D	MW-4S/MW-4D	MW-5S/MW-5D	MW-6S/MW-6D
4/07/92	*0.0010 down	0.0039 down	0.0013 down	0.0024 down	0.0039 down
4/09/92	*0.0010 down	0.0033 down	0.0035 down	0.0016 down	0.0054 down
4/15/92	0.0020 down	0.0033 down	0.0035 down	0.0016 down	0.0054 down
4/21/92	0.0031 down	0.0033 down	0.0031 down	*0.0008 down	0.0046 down
5/07/92	0.0031 down	0.0026 down	0.0035 down	*0.0008 down	0.0039 down
5/27/92	0.0020 down	0.0033 down	0.0040 down	0.0016 down	0.0039 down

*The difference between elevation measurements is at the limit of measurement accuracy.

TABLE 2.4-2

BACKGROUND SOIL SAMPLE
CONCENTRATION RANGES

(concentrations in mg/kg)

	EPA DESIGNATED BACKGROUND SAMPLES (BS01, BS02 & BS04)	FINAL WORKPLAN BACKGROUND SAMPLES (BS01-BS08)
Aluminum	1520 - 1930	881 - 4560
Antimony	<2.3	<2.3 - 5.8
Arsenic	1.7 - 2	<0.76 - 235
Barium	6.4 - 22.2	5.1 - 232
Beryllium	<0.17	<0.12 - 0.4
Cadmium	<0.62	<0.61 - 7.3
Calcium	16200 - 31900	16200 - 36100
Chromium, total	<5.3 - 18.1	<5.1 - 231
Cobalt	1.8 - 2.4	1.6 - 7.3
Copper	4.3 - 7.1	3.9 - 160
Iron	3710 - 4330	2560 - 39700
Lead	3.6 - 9.2	3.4 - 434
Magnesium	7670 - 16200	7670 - 17300
Manganese	78.6 - 163	78.6 - 357
Mercury	<0.08	<0.07 - 1.7
Nickel	3.2 - 4.8	2.6 - 33.3
Potassium	278 - 403	<151 - 680
Selenium	<0.27	<0.27 - 0.93
Silver	<0.36 - 0.71	<0.36 - 5.4
Sodium	<339	<447
Thallium	<0.23	<0.40
Vanadium	5.6 - 8	4.4 - 14.9
Zinc	19.2 - 27.6	17.6 - 764
Cyanide	<0.19	<0.19 - 0.79

wcpmet.prn

TABLE 2.4-2 (cont.)

BACKGROUND SOIL SAMPLE
CONCENTRATION RANGES

(concentrations in ug/kg)

	EPA DESIGNATED BACKGROUND SAMPLES (BS01, BS02 & BS04)	FINAL WORKPLAN BACKGROUND SAMPLES (BS01-BS08)
Chloromethane	<11	<13
Bromomethane	<11	<13
Vinyl Chloride	<11	<13
Chloroethane	<11	<13
Methylene Chloride	<32	<51
Acetone	<23	<51
Carbondisulfide	<11	<12
1,1-Dichloroethylene	<11	<13
1,1-Dichloroethane	<11	<13
1,2-Dichloroethylene	<11	<13
Chloroform	<11	<12
1,2-Dichloroethane	<11	<13
Methyl Ethyl Ketone	<11	<11 - 20
1,1,1-Trichloroethane	<11	<13
Carbon Tetrachloride	<11	<13
Bromodichloromethane	<11	<13
1,2-Dichloropropane	<11	<13
Cis-1,3-Dichloro-1-propene	<11	<13
Trichloroethylene	<11	<12
Chlorodibromomethane	<11	<13
1,1,2-Trichloroethane	<11	<13
Trans-1,3-Dichloro-1-propene	<11	<13
Bromoform	<11	<13
Methyl Isobutyl Ketone	<11	<13
2-Hexanone	<11	<13
Tetrachloroethylene	<11	<13
1,1,2,2-Tetrachloroethane	<11	<13
Chlorobenzene	<11	<13
Styrene	<11	<13
Benzene	<11	<13
Ethyl Benzene	<11	<13
Toluene	<11	<12
Xylenes	<11	<12

wcpvoc.prn

TABLE 2.4-2 (cont.)

BACKGROUND SOIL SAMPLE
CONCENTRATION RANGES

(concentrations in ug/kg)

PROJECT SPECIFIC PAH COMPOUNDS	EPA DESIGNATED BACKGROUND SAMPLES (BS01, BS02 & BS04)	FINAL WORKPLAN BACKGROUND SAMPLES (BS01-BS08)
	-----	-----
Naphthalene	<350	<400
2-Methylnaphthalene	<350	<400
Acenaphthylene	<350	<350 - 590
Acenaphthene	<350	<400
Dibenzofuran	<350	<400
Fluorene	<350	<400
Phenanthrene	<350	68 - 1300
Anthracene	<350	<350 - 560
Fluoranthene	<350	47 - 2400
Pyrene	<350	35 - 2600
Benzo(ghi)perylene	<350	89 - 810
Benzo(a)anthracene	<350	40 - 1600
Benzo(b)fluoranthene	<350	42 - 2000
Benzo(k)fluoranthene	<350	46 - 1100
Benzo(a)pyrene	<350	46 - 1400
Chrysene	<350	40 - 1700
Dibenzo(ah)anthracene	<350	<350 - 440
Indeno(1,2,3,cd)pyrene	<350	40 - 1100
PHENOLIC COMPOUNDS		
Phenol	<350	<450
2-Chlorophenol	<350	<450
o-Cresol	<350	<450
p-Cresol	<350	<450
2-Nitrophenol	<350	<450
2,4-Dimethylphenol	<350	<450
4-Chloro-3-methylphenol	<350	<450
2,4,6-Trichlorophenol	<350	<450
2,4,5-Trichlorophenol	<840	<1100
2,4-Dinitrophenol	<840	<1100
4-Nitrophenol	<840	<1100
2-Methyl-4,6-dinitrophenol	<840	<1100
Pentachlorophenol	<840	<1100

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TABLE 2.4-2 (cont.)

BACKGROUND SOIL SAMPLE
CONCENTRATION RANGES

(concentrations in ug/kg)

	EPA DESIGNATED BACKGROUND SAMPLES (BS01, BS02 & BS04)	FINAL WORKPLAN BACKGROUND SAMPLES (BS01-BS08)

OTHER SEMI-VOLATILE COMPOUNDS		
Bis(2-chloroethyl)ether	<350	<450
1,3-Dichlorobenzene	<350	<450
1,4-Dichlorobenzene	<350	<450
1,2-Dichlorobenzene	<350	<450
Bis(2-chloroisopropyl)ether	<350	<450
N-Nitrosodi-n-propylamine	<350	<450
Hexachloroethane	<350	<450
Nitrobenzene	<350	<450
Isophorone	<350	<450
Bis(2-chloroethoxy)methane	<350	<450
1,2,4-Trichlorobenzene	<350	<450
4-Chloroaniline	<350	<450
Hexachlorobutadiene	<350	<450
Hexachlorocyclopentadiene	<350	<450
2-Chloronaphthalene	<350	<450
2-Nitroaniline	<850	<1100
Dimethyl phthalate	<350	<450
2,6-Dinitrotoluene	<350	<450
3-Nitroaniline	<850	<1100
2,4-Dinitrotoluene	<350	<450
Diethyl phthalate	<350	<450
4-Chlorophenyl phenyl ether	<350	<450
4-Nitroaniline	<850	<1100
N-Nitrosodiphenylamine	<350	<450
4-Bromophenyl phenyl ether	<350	<450
Hexachlorobenzene	<350	<450
Di-n-butyl phthalate	<350	<450
Butyl benzyl phthalate	<350	<450
3,3-Dichlorobenzidine	<350	<450
Bis(2-ethylhexyl)phthalate	<420	<350 - 4500
Di-n-octyl phthalate	<350	<450
Carbazole	<350	<400
2,4-Dichlorophenol	<350	<450

wcpbnc.prn

TABLE 2.4-2 (cont.)

BACKGROUND SOIL SAMPLE
CONCENTRATION RANGES

(concentrations in ug/kg)

	EPA DESIGNATED BACKGROUND SAMPLES (BS01, BS02 & BS04)	FINAL WORKPLAN BACKGROUND SAMPLES (BS01-BS08)
a-BHC	<7.2	<120
b-BHC	<7.2	<120
d-BHC	<7.2	<120
g-BHC (Lindane)	<7.2	<120
Heptachlor	<7.2	<120
Aldrin	<7.2	<120
Heptachlor Epoxide	<7.2	<120
Endosulfan I	<7.2	<120
Dieldrin	<14	<230
4,4'-DDE	<14	<230
Endrin	<14	<230
Endosulfan II	<14	<230
4,4'-DDD	<14	<230
Endosulfan Sulfate	<14	<230
4,4'-DDT	<14	<230
Methoxychlor	<72	<1200
Endrin Ketone	<14	<230
Endrin Aldehyde	<14	<230
cis-Chlordane	<7.2	<120
trans-Chlordane	<7.2	<120
Toxaphene	<720	<12000
PCB-1016	<140	<2300
PCB-1221	<280	<4600
PCB-1232	<140	<2300
PCB-1242	<140	<2300
PCB-1248	<35 - 1500	<35 - 23000
PCB-1254	<140	<2300
PCB-1260	<35 - 69	<35 - 850

wcpes.prn

TABLE 2.4-3

MANUFACTURED GAS PLANT/COKING AND CREOSOTE
COMPOUNDS FREQUENTLY DETECTED ON-SITE

MGP/COKING COMPOUNDS	MGP/COKING AND CREOSOTE COMPOUNDS		
INORGANICS	VOLATILE ORGANIC COMPOUNDS	POLYNUCLEAR AROMATIC HYDROCARBONS	PHENOLIC COMPOUNDS
Arsenic Cyanide	Benzene Ethyl Benzene Toluene Xylenes	Naphthalene 2-Methylnaphthalene Acenaphthylene Acenaphthene Dibenzofuran Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(g,h,i)perylene Benzo(a)anthracene* Benzo(b)fluoranthene* Benzo(k)fluoranthene* Benzo(a)pyrene* Chrysene* Dibenzo(a,h)anthracene* Indeno(1,2,3-cd)pyrene*	Phenol o-Cresol p-Cresol 2,4-Dimethylphenol

* Suspected carcinogens.

TABLE 2.4-4

SOIL QUALITY DATA SUMMARY
MGP/COKING AND CREOSOTE COMPOUNDS

SAMPLE NO.	DATE COLLECTED	DEPTH (ft.)	PARAMETERS ANALYZED					
			TOTAL BETX (µg/kg)	TOTAL PAH (µg/kg)	TOTAL cPAH (µg/kg)	PHENOL (µg/kg)	ARSENIC (mg/kg)	CYANIDE (mg/kg)
POTENTIAL SOURCE AREA INVESTIGATION SAMPLES								
SC-01	03/07/92	2.0-4.0	ND	43	ND	410 U	0.60 UJ	--
SC-02	03/07/92	2.0-4.0	2.0	12,000	4,500	440 U	61.6 J	--
TT-01-02	03/06/92	4.0	10,000	2,800,000	120,000	80,000 U	--	--
TT-02-04	03/05/92	2.5	ND	--	--	--	--	--
TT-02-06	03/05/92	2.5	--	100,000	57,000	290 J	--	--
TT-02-09	03/05/92	1.0	--	11,000	7,300	360 U	--	--
TT-03-01	03/10/92	4.0	7,900	1,000,000	ND	--	360	8.0 J
TT-03-02	03/10/92	4.0	8,500	880,000	240,000	26,000	--	--
TT-03-03	03/11/92	4.0	2.0	43	ND	--	--	--
TT-03W-01	03/13/92	4.0	110,000	4,300,000	ND	490,000 U	236	956
TT-03W-02	03/13/92	3.5	480,000	5,000,000	570,000	41,000 J	20.6	--
TT-04-03	03/05/92	6.0	--	8,800	4,600	410 U	--	--
TT-05E-01	03/10/92	5.0	3	16,000	8,400	--	--	--
TT-06-02	03/09/92	4.5	180	1,000,000	29,000	38,000 U	0.92 B	--
TT-06-04	03/09/92	2.5	10	8,900	4,000	370 U	6.5	--
TT-07-01	03/19/92	4.5	--	--	--	--	1,820	13.7 J
TT-07-03	03/19/92	4.5	14,000	2,100,000	22,000	210,000 U	--	--
TT-08-02	03/21/92	4.0	1,900	600,000	14,000	60,000 U	--	--
TT-08A-01	03/21/92	5.0	23	--	--	--	304	52.4 J
TT-09-02	03/11/92	6.0	3	340	89	--	--	--
TT-10-01	03/21/92	7.0	180,000	920,000*	ND	140,000 U*	318*	2.5 BJ*

TABLE 2.4-4 (cont.)

SOIL QUALITY DATA SUMMARY
MGP/COKING AND CREOSOTE COMPOUNDS

SAMPLE NO.	DATE COLLECTED	DEPTH (ft.)	PARAMETERS ANALYZED					
			TOTAL BETX (μg/kg)	TOTAL PAH (μg/kg)	TOTAL cPAH (μg/kg)	PHENOL (μg/kg)	ARSENIC (mg/kg)	CYANIDE (mg/kg)
TT-12-01	03/18/92	4.0	99,000	990,000	ND	130,000	--	--
TT-13-01	03/16/92	4.5	12	ND	ND	--	--	--
TT-14-02	03/18/92	4.0	12,000	70,000	5,600	1,600 U	38.0	28.5 J
TT-15-01	03/17/92	5.5	9*	3,200	40	--	--	--
TT-16-02	03/12/92	4.5	ND	2,100	780	--	--	--
TT-17-01	03/12/92	4.5	ND	42	ND	400 U	--	--
TT-19-01	03/17/92	4.5	2,800	570,000	100,000	--	--	--
TT-21-01	03/16/92	4.5	ND	12,000	5,500	--	--	--
TT-22-01	03/12/92	3.5	ND	--	--	--	--	--
TT-23-03	03/19/92	4.0	600,000	--	--	--	--	--
BACKGROUND SOIL SAMPLES								
BS-01	03/05/92	2.0-4.0	ND	120	40	350 U	1.7 B	0.19 U
BS-02	03/05/92	2.0-4.0	4	420	180	350 U	2.0 B	0.19 U
BS-03	03/05/92	2.0-4.0	9	18,000	9,300	450 U	235	0.25 U
BS-04	03/05/92	2.0-4.0	ND	ND	ND	350 U	1.9 B	0.19 U
BS-05	03/05/92	2.0-4.0	ND	820	370	390 U	0.76 UJ	0.22 U
BS-06	03/25/92	2.0-4.0	9	89	ND	350 UJ	1.7 BJ	1.2 BJ*
BS-07	03/25/92	2.0-4.0	2	ND	ND	390 UJ	2.2 BJ	0.22 R
BS-08	03/25/92	2.0-4.0	1	ND	ND	400 UJ	2.8 J	0.22 R

TABLE 2.4-4 (cont.)

SOIL QUALITY DATA SUMMARY
MGP/COKING AND CREOSOTE COMPOUNDS

SAMPLE NO.	DATE COLLECTED	DEPTH (ft.)	PARAMETERS ANALYZED					
			TOTAL BETX (μg/kg)	TOTAL PAH (μg/kg)	TOTAL cPAH (μg/kg)	PHENOL (μg/kg)	ARSENIC (mg/kg)	CYANIDE (mg/kg)
SURFICIAL SOIL SAMPLES								
SS-01	03/10/92	2.0-4.0	ND	170	40	380 U	7.2	--
SS-02	03/06/92	2.0-4.0	5*	1,700	690	390 U	1.1 U	--
SS-03	03/06/92	2.0-4.0	1	5,000	1,000	430 U	5.6	--
SS-04	03/06/92	2.0-4.0	5	3,200	1,200	390 U	2.6	--
SS-05	03/06/92	2.0-4.0	ND	25,000	8,900	400 U	3.7	--
SS-06	03/11/92	2.0-4.0	ND	970	370	400 U	5.5	--
SS-07	03/10/92	2.0-4.0	14	11,000	140	390 U	4.2	--
SS-08	03/11/92	2.0-4.0	ND	64,000	21,000	14,000	91.5	--
SS-09	03/11/92	2.0-4.0	ND	ND	ND	410 U	8.7	--
SS-10	03/11/92	2.0-4.0	ND	2,500	1,500	390 U	6.3	--
SS-11	03/11/92	2.0-4.0	ND	1,800	900	370 U	1.4 B	--
SS-12	03/11/92	2.0-4.0	ND	ND	ND	400 U	1.3 B	--
SS-13	03/12/92	2.0-4.0	ND	770	380	380 U	1.5 B	--
SS-14	03/12/92	2.0-4.0	94	650,000	140,000	1,200 J	4.4	--
SS-15	03/12/92	2.0-4.0	2	5,600	3,300	63 J	3.6 UJ	--
SS-16	03/07/92	2.0-4.0	ND	960	270	400 U	10.8 J	--
SS-17	03/07/92	2.0-4.0	1	41,000	15,000	62 J	1.1 UJ	--

TABLE 2.4-4 (cont.)

SOIL QUALITY DATA SUMMARY
MGP/COKING AND CREOSOTE COMPOUNDS

SAMPLE NO.	DATE COLLECTED	DEPTH (ft.)	PARAMETERS ANALYZED					
			TOTAL BETX (µg/kg)	TOTAL PAH (µg/kg)	TOTAL cPAH (µg/kg)	PHENOL (µg/kg)	ARSENIC (mg/kg)	CYANIDE (mg/kg)
PILOT BORING SAMPLES								
SB-04-03	03/20/92	30.0-32.0	22	ND	ND	35,000	--	--
SB-06-01	03/24/92	22.5-24.5	180	3,500	ND	37,000 J	--	--
MW-3D	03/18/92	26.0-28.0	4	ND	ND	71,000	--	--

BETX Benzene, ethyl benzene, toluene, xylenes
 PAH Polynuclear aromatic hydrocarbons
 cPAH Carcinogenic polynuclear aromatic hydrocarbons
 PEST Pesticides
 PCB Polychlorinated biphenyls

B Reported value is less than the Contract Reporting Detection Limit but greater than or equal to the Instrument Detection Limit.
 J Associated value is an estimate.
 U Not detected at the stated quantitation limit.
 ND None detected.

*Indicates data from duplicate (when the concentration in the duplicate was greater than the concentration in the sample).

TABLE 2.4-5

COMPARISON OF OIL SHEEN RESULTS TO
TOTAL PAH AND cPAH CONCENTRATIONS

OIL SHEEN	RANGE OF TOTAL PAH CONCENTRATIONS ($\mu\text{g/kg}$) (Average Total PAH Concentrations in $\mu\text{g/kg}$)	RANGE OF TOTAL cPAH CONCENTRATIONS ($\mu\text{g/kg}$) (Average cPAH Concentrations in $\mu\text{g/kg}$)
None	ND - 41,000 (6,600)	ND - 15,000 (3,400)
Trace	170 - 880,000 (270,000)	40 - 240,000 (67,000)
Moderate to Heavy	970 - 5,000,000 (1,500,000)	40 - 570,000 (96,000)

TABLE 2.4-6

SOIL QUALITY
NATURALLY OCCURRING CONCENTRATIONS OF INORGANICS

PARAMETER	NATURAL COMPOSITION OF SOILS (mg/kg)			
	BOWEN, 1966	SHACKLETTE & BOERNGEN, 1984	DRAGUN, 1988	REPRESENTATIVE UPPER RANGE CONCENTRATION ¹
Aluminum	10,000-300,000	700-<100,000	10,000-300,000	100,000
Antimony	--	<1-8.8	0.6-10	8.8
Arsenic	0.1-40	<0.1-97	1.0-40	40
Barium	100-3,000	10-5,000	100-3,500	3,000
Beryllium	0.1-40	<1-15	0.1-40	15
Cadmium	0.01-0.7	--	0.01-7.0	7.0 ²
Calcium	7,000-500,000	100-320,000	100-400,000	320,000
Chromium, total	5-3,000	1-2,000	5.0-3,000	2,000
Cobalt	1-40	<3-70	1.0-40	40
Copper	2-100	<1-700	2.0-100	100
Iron	7,000-550,000	100->100,000	7,000-550,000	100,000
Lead	2-200	<10-700	2.0-200	200
Magnesium	600-6,000	50->100,000	600-6,000	6,000
Manganese	100-4,000	<2-7,000	100-4,000	4,000
Mercury	0.01-0.3	<0.01-4.6	0.01-0.08	0.3 ²
Nickel	10-1,000	<5-700	5.0-1,000	700
Potassium	400-30,000	50-63,000	400-30,000	30,000
Selenium	0.01-2	<0.1-4.3	0.1-2.0	2.0
Silver	0.01-5	--	0.1-5.0	5.0
Sodium	750-7,500	<500-100,000	750-7,500	7,500
Thallium	0.1-12	2.2-31	0.1-12	12
Vanadium	20-500	<7-500	20-500	500
Zinc	10-300	<5-2,900	10-300	300
Cyanide	--	--	--	--

¹The lowest of the upper range concentrations was chosen to be the representative upper range concentration.

²Selected value is the lowest value that exceeds method detection limits for analyzed soil samples.

TABLE 2.4-7

MAXIMUM VOLATILE ORGANIC COMPOUND CONCENTRATIONS¹
SOIL QUALITY

PARAMETER	FREQUENCY OF DETECTION ² (Maximum Concentration in $\mu\text{g/kg}$)			
	BS	TT&SC	SS	SB
Methylene Chloride	3/9 (4)	6/29 (4,500)	2/18 (120)	1/3 (19)
Acetone	ND	5/29 (150)	1/18 (29)	3/3 (170)
Carbon disulfide	ND	17/29 (640)	8/18 (7)	2/3 (4)
1,1-Dichloroethane	ND	1/29 (1)	ND	ND
1,2-Dichloroethylene	ND	1/29 (4)	ND	ND
Chloroform	ND	4/29 (13)	2/18 (4)	ND
Methyl Ethyl Ketone	2/9 (20)	13/29 (64)	5/18 (13)	2/3 (37)
1,1,1-Trichloroethane	ND	1/29 (6)	1/18 (6)	ND
Trichloroethylene	1/9 (2)	1/29 (2)	1/18 (1)	ND
2-Hexanone	ND	ND	ND	1/3 (3)
Styrene	ND	3/29 (62,000)	1/18 (5)	ND

¹Excluding benzene, toluene, xylenes, and ethyl benzene.

²Entries show the number of samples in which the parameter was detected over the total number of samples analyzed for the parameter. The number in parentheses is the maximum concentration detected.

BS Background Soil Sample.

TT&SC Potential Source Area Investigation Sample.

SS Surficial Soil Sample.

SB Pilot Boring Soil Sample.

ND Not detected.

TABLE 2.4-8

PHASE II ANALYTICAL PARAMETERS - SOIL QUALITY
(Chemical Constituents)

INORGANICS	VOLATILE ORGANIC COMPOUNDS ¹	POLYNUCLEAR AROMATIC HYDROCARBONS ¹	PHENOLIC COMPOUNDS ¹
Arsenic Cadmium Lead Mercury Selenium Cyanide	Benzene Ethyl benzene Toluene Xylenes	Naphthalene 2-Methylnaphthalene Acenaphthylene Acenaphthene Dibenzofuran Fluorene Phenanthrene Anthracene Fluoranthene Pyrene Benzo(a)anthracene Chrysene Benzo(b+k)fluoranthene Benzo(a)pyrene Indeno(1,2,3-cd)pyrene Dibenzo(a,h)anthracene Benzo(g,h,i)perylene Carbazole	Phenol o-Cresol p-Cresol 2,4-Dimethylphenol

¹ The laboratory will indicate when criteria were not met for estimating concentrations below the quantitation limit.

TABLE 2.4 - 9

CARBON FILTER TREATMENT UNIT
INFLUENT, EFFLUENT
INORGANICS

(concentrations in ug/L)

	UNTREATED INFLUENT CPIINF1 ----- 04/09/92	TREATED EFFLUENT CPEFF1 ----- 04/09/92
Aluminum	72.3 U	49.3 U
Antimony	10.9 U	45.3 U
Arsenic	9160	18200
Barium	213	297
Beryllium	0.19 U	0.19 U
Cadmium	8.7	16.2
Calcium	52500	33300
Chromium, total	12.3 J	2.1 UJ
Cobalt	6.2 B	3.6 U
Copper	205 J	91.2 J
Iron	587	341
Lead	4.5	3.8
Magnesium	20100	28500
Manganese	326	117
Mercury	0.16 U	0.16 U
Nickel	33.5 U	24.4 U
Potassium	10900	18700
Selenium	24.6 J	6.0 UJ
Silver	1.7 U	1.7 U
Sodium	115000 J	207000 J
Thallium	1.7 U	1.7 U
Vanadium	64.1	18.2 B
Zinc	113	33.9
Cyanide	170	378

U Not detected.

J Associated value is an estimate.

B The reported value is less than the Contract Reporting Detection Limit (CRDL)
but greater than or equal to the Instrument Detection Limit (IDL).

.023

08/20/92

TABLE 2.4 - 10

CARBON FILTER TREATMENT UNIT
INFLUENT, EFFLUENT
VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	UNTREATED INFLUENT CFINF1 ----- 04/09/92	TREATED EFFLUENT CFEFL1 ----- 04/09/92
Chloromethane	20 U	10 U
Bromomethane	20 U	10 U
Vinyl Chloride	20 U	10 U
Chloroethane	20 U	10 U
Methylene Chloride	20 U	10 U
Acetone	250	10 U
Carbondisulfide	20 U	10 U
1,1-Dichloroethylene	20 U	10 U
1,1-Dichloroethane	28	10 U
1,2-Dichloroethylene	20 U	10 U
Chloroform	20 U	10 U
1,2-Dichloroethane	20 U	10 U
Methyl Ethyl Ketone	80 U	10 U
1,1,1-Trichloroethane	2 J	10 U
Carbon Tetrachloride	20 U	10 U
Bromodichloromethane	20 U	10 U
1,2-Dichloropropane	20 U	10 U
Cis-1,3-Dichloro-1-propene	20 U	10 U
Trichloroethylene	20 U	10 U
Chlorodibromomethane	20 U	10 U
1,1,2-Trichloroethane	20 U	10 U
Trans-1,3-Dichloro-1-propene	20 U	10 U
Bromoform	20 U	10 U
Methyl Isobutyl Ketone	20 U	10 U
2-Hexanone	20 U	10 U
Tetrachloroethylene	20 U	10 U
1,1,2,2-Tetrachloroethane	20 U	10 U
Chlorobenzene	20 U	10 U
Styrene	2 J	10 U
Benzene	220	10 U
Ethyl Benzene	8 J	10 U
Toluene	45	10 U
Xylenes	21	10 U
Sum of BETX	290	ND

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Associated value is an estimate.

.023

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TABLE 2.4 - 11

CARBON FILTER TREATMENT UNIT
INFLUENT, EFFLUENT
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

PROJECT SPECIFIC PAH COMPOUNDS	UNTREATED	TREATED
	INFLUENT	EFFLUENT
	CFINF1	CPEFF1
	-----	-----
	04/09/92	04/09/92
Naphthalene	15000 U	10 U
2-Methylnaphthalene	15000 U	10 U
Acenaphthylene	15000 U	10 U
Acenaphthene	15000 U	10 U
Dibenzofuran	15000 U	10 U
Fluorene	15000 U	10 U
Phenanthrene	15000 U	10 U
Anthracene	15000 U	10 U
Fluoranthene	15000 U	10 U
Pyrene	15000 U	10 U
Benzo(ghi)perylene	15000 U	10 U
Benzo(a)anthracene	15000 U	10 U
Benzo(b)fluoranthene	15000 U	10 U
Benzo(k)fluoranthene	15000 U	10 U
Benzo(a)pyrene	15000 U	10 U
Chrysene	15000 U	10 U
Dibenzo(ah)anthracene	15000 U	10 U
Indeno(1,2,3,cd)pyrene	15000 U	10 U
Sum of Carcinogenic PAHs	ND	ND
Sum of PAHs	ND	ND

PHENOLIC COMPOUNDS

Phenol	260000	10 U
2-Chlorophenol	15000 U	10 U
o-Cresol	49000	10 U
p-Cresol	130000	4 J
2-Nitrophenol	15000 U	10 U
2,4-Dimethylphenol	13000 J	10 U
4-Chloro-3-methylphenol	15000 U	10 U
2,4,6-Trichlorophenol	15000 U	10 U
2,4,5-Trichlorophenol	38000 U	25 U
2,4-Dinitrophenol	38000 U	25 U
4-Nitrophenol	38000 U	25 U
2-Methyl-4,6-dinitrophenol	38000 U	25 U
Pentachlorophenol	38000 U	25 U

ND None detected.

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

J Reported value is an estimate.

.021

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TABLE 2.4 - 11 (cont.)

CARBON FILTER TREATMENT UNIT
INFLUENT, EFFLUENT
SEMI-VOLATILE ORGANIC COMPOUNDS

(concentrations in ug/L)

	UNTREATED INFLUENT CPINF1	TREATED EFFLUENT CPEFF1
	-----	-----
OTHER SEMI-VOLATILE COMPOUNDS	04/09/92	04/09/92
Bis(2-chloroethyl) ether	15000 U	10 U
1,3-Dichlorobenzene	15000 U	10 U
1,4-Dichlorobenzene	15000 U	10 U
1,2-Dichlorobenzene	15000 U	10 U
Bis(2-chloroisopropyl) ether	15000 U	10 U
N-Nitrosodi-n-propylamine	15000 U	10 U
Hexachloroethane	15000 U	10 U
Nitrobenzene	15000 U	10 U
Isophorone	15000 U	10 U
Bis(2-chloroethoxy) methane	15000 U	10 U
1,2,4-Trichlorobenzene	15000 U	10 U
4-Chloroaniline	15000 U	10 U
Hexachlorobutadiene	15000 U	10 U
Hexachlorocyclopentadiene	15000 U	10 U
2-Chloronaphthalene	15000 U	10 U
2-Nitroaniline	38000 U	25 U
Dimethyl phthalate	15000 U	10 U
2,6-Dinitrotoluene	15000 U	10 U
3-Nitroaniline	38000 U	25 U
2,4-Dinitrotoluene	15000 U	10 U
Diethyl phthalate	15000 U	10 U
4-Chlorophenyl phenyl ether	15000 U	10 U
4-Nitroaniline	38000 U	25 U
N-Nitrosodiphenylamine	15000 U	10 U
4-Bromophenyl phenyl ether	15000 U	10 U
Hexachlorobenzene	15000 U	10 U
Di-n-butyl phthalate	15000 U	10 U
Butyl benzyl phthalate	15000 U	10 U
3,3-Dichlorobenzidine	15000 U	10 U
Bis(2-ethylhexyl) phthalate	15000 U	10 U
Di-n-octyl phthalate	15000 U	10 U
Carbazole	15000 U	10 U
2,4-Dichlorophenol	15000 U	10 U

U Not detected. Note that the laboratory would have reported, with a J qualifier, any detected concentration below the stated quantitation limit but above the laboratory's method detection limit. The laboratory's method detection limit is typically about 10 percent of the stated quantitation limit in the table.

.021

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TABLE 2.4 - 12

CARBON FILTER TREATMENT UNIT
INFLUENT, EFFLUENT
PESTICIDES AND PCBs

(concentrations in ug/L)

	UNTREATED INFLUENT CFINFI	TREATED EFFLUENT CFEFP1
	-----	-----
	04/09/92	04/09/92
a-BHC	0.10 UJ	0.050 U
b-BHC	0.10 UJ	0.050 U
d-BHC	0.10 UJ	0.050 U
g-BHC (Lindane)	0.10 UJ	0.050 UJ
Heptachlor	0.10 UJ	0.050 UJ
Aldrin	0.10 UJ	0.050 U
Heptachlor Epoxide	0.10 UJ	0.050 U
Endosulfan I	0.10 UJ	0.050 U
Dieldrin	0.20 UJ	0.10 U
4,4'-DDE	0.20 UJ	0.10 U
Endrin	0.20 UJ	0.10 U
Endosulfan II	0.20 UJ	0.10 U
4,4'-DDD	0.20 UJ	0.10 U
Endosulfan Sulfate	0.20 UJ	0.10 U
4,4'-DDT	0.20 UJ	0.10 U
Methoxychlor	1.0 UJ	0.50 U
Endrin Ketone	0.20 UJ	0.10 U
Endrin Aldehyde	0.20 UJ	0.10 U
cis-Chlordane	0.10 UJ	0.050 U
trans-Chlordane	0.10 UJ	0.050 U
Toxaphene	10 UJ	5.0 U
PCB-1016	2.0 UJ	1.0 U
PCB-1221	4.0 UJ	2.0 U
PCB-1232	2.0 UJ	1.0 U
PCB-1242	2.0 UJ	1.0 U
PCB-1248	2.0 UJ	1.0 U
PCB-1254	2.0 UJ	1.0 U
PCB-1260	2.0 UJ	1.0 U

U Not detected.

J Associated value is an estimate.

.023

08/20/92

TABLE 2.4-13

GROUNDWATER QUALITY DATA SUMMARY
MGP/COKING AND CREOSOTE COMPOUNDS

SAMPLE NO.	DATE COLLECTED	PARAMETERS ANALYZED					
		TOTAL BETX ($\mu\text{g/L}$)	TOTAL PAH ($\mu\text{g/L}$)	TOTAL cPAH ($\mu\text{g/L}$)	PHENOL ($\mu\text{g/L}$)	ARSENIC ($\mu\text{g/L}$)	CYANIDE ($\mu\text{g/L}$)
MW1S1	04/09/92	80	1,800	ND	100 U	120	103
MW3S1	04/07/92	ND	ND	ND	110	134	115
MW4S1	04/07/92	ND	350	27	450	18.4	7.1 B
MW5S1	04/08/92	70	ND	ND	47	243	5.0 B
MW6S1	04/08/92	270*	2,000	ND	340	387*	17.1*
MW1D1	04/09/92	1,100	ND	ND	760,000	4,020	448
MW3D1	04/07/92	1,100	ND	ND	94,000	7,110	200
MW4D1	04/07/92	460	ND	ND	1,500,000	27,100*	706
MW5D1	04/08/92	560	ND	ND	150 U	9,220	526
MW6D1	04/08/92	2,200	ND	ND	690,000 J	14,600	632

BETX Benzene, ethyl benzene, toluene, and xylenes.

PAH Polynuclear aromatic hydrocarbons.

cPAH Carcinogenic polynuclear aromatic hydrocarbons.

* Indicates data from duplicate when duplicate concentration is greater than sample concentration.

ND None detected.

U Not detected.

B The reported value is less than the Contract Reporting Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).

J Associated value is an estimate.

TABLE 2.4-14

PHASE II VOLATILE ORGANIC ANALYTICAL PARAMETERS
GROUNDWATER QUALITYVolatile Organic Compounds (EPA SW846-Method 8240)

Chloromethane	Trichloroethene
Bromomethane	Dibromochloromethane
Vinyl Chloride	1,1,2-Trichloroethane
Chloroethane	Benzene
Methylene Chloride	trans-1,3-Dichloropropene
Acetone	2-Chloroethylvinylether
Carbon Disulfide	Bromoform
Trichlorofluoromethane	2-Hexanone
1,1-Dichloroethene	4-Methyl-2-Pentanone
1,1-Dichloroethane	Tetrachloroethene
1,2-Dichloroethene (total)	1,1,2,2-Tetrachloroethane
Chloroform	Toluene
1,2-Dichloroethane	Chlorobenzene
2-Butanone (MEK)	Ethylbenzene
1,1,1-Trichloroethane	Styrene
Carbon Tetrachloride	Xylenes (total)
Vinyl Acetate	1,3-Dichlorobenzene
Bromodichloromethane	1,4-Dichlorobenzene
1,2-Dichloropropane	1,2-Dichlorobenzene
cis-1,3-Dichloropropene	

TABLE 2.4-15

APPROXIMATE AREAS OF ECOLOGICAL FEATURES

ECOLOGICAL FEATURE	% OF PROJECT SITE	NUMBER OF ACRES
Old Field Community	57	20.6
Lawn	5	1.8
Subtotal Vegetated Area	(62)	(22.4)
Buildings	2	0.7
Asphalt	9	3.1
Larsen Marine Boat and Rack Storage	11	4.1
Stockpiled Dredge Spoils Area	10	3.4
Covered Contaminated Soils Stockpile	2	0.8
Surface Water - New Slip	4	1.5
Subtotal Nonvegetated Area	(38)	(13.6)
TOTAL	100	36.0

TABLE 3.2-1

PHASE II RI SAMPLING SUMMARY

SAMPLING ACTIVITY	OBJECTIVE	ESTIMATED NO. OF SAMPLES	ANALYTICAL PARAMETERS	RATIONALE FOR SAMPLE SELECTION
Soils Investigation	Stratigraphic characterization and qualitative identification of PAH-contaminated soil for selection of samples for analyses	648	Field Soil Classification, Visual Examination, Field Oil Sheen Test, Odor Observations, Field Headspace Organic Vapor Screening, Field pH	Split-barrel samples collected from borings at ~2-foot intervals
	Assess vertical and horizontal extent of key chemical constituents	140	PAHs, BETX, Phenols, Arsenic, Cadmium, Lead, Mercury, Selenium, Cyanide	1 Unsaturated zone sample from each boring; 1 sample from sand/till contact at each boring; 1 sample from a depth interval of 7 to 9 feet; 1 sample from a depth interval of 17 to 19 feet; additional samples based on visual contamination, stratigraphy
	Assess the distribution of key chemical constituents in soils present at the ground surface	15	PAHs, BETX, Phenols, Arsenic, Cadmium, Lead, Mercury, Selenium, Cyanide	1 Ground surface sample from each of 12 on-site locations; 1 sample from each of 3 off-site background sample locations
	Characterize soil quality and lithology of designated soil stockpile	3	Phase I Full-Scan Parameters	1 Sample from a depth of approximately 18 inches at each of three locations
	Characterize soil quality and lithology of soil stockpile	9	Phase I Full-Scan Parameters	At each boring: 1 sample from 4.5 to 6.5 feet and 1 sample from 14.5 to 16.5 feet below the top of the stockpile; and 1 sample from 2 to 4 feet below the base of the stockpile
	Assess vertical and horizontal extent of key chemical constituents and characteristics associated with thionizer process	6	PAHs, BETX, Phenols, Cadmium, Lead, Mercury, Selenium, Arsenic, Cyanide, Corrosivity, Reactivity	1 Sample from a depth interval of 2 to 4 feet from each of 5 borings near thionizer building/sulfur pile; and 1 ground surface soil sample from the area of the former thionizer building sulfur pile
	Determine basic soil characteristic data	6	Grain Size Distribution, Porosity	3 Samples from till, 3 from sand to provide areally representative samples
	Determine basic soil characteristic data	3	Atterberg Limits	1 Sample of till from each of 3 borings to provide areally representative samples

TABLE 3.2-1 (Cont.)

PHASE II RI SAMPLING SUMMARY

SAMPLING ACTIVITY	OBJECTIVE	ESTIMATED NO. OF SAMPLES	ANALYTICAL PARAMETERS	RATIONALE FOR SAMPLE SELECTION
Soils (Cont.)	Assess adsorptive nature of sand and till units	6	Total Organic Carbon, Cation Exchange Capacity	3 Samples from till, 3 from sand to provide areally representative samples
	Assess vertical permeability of till	3	Vertical Permeability	1 Sample from each of 3 borings to provide areally representative samples
	Assess potential treatability alternatives	3	Gross Heating Value, Flashpoint, Oil and Grease	1 Sample from each of the three different areas of soils identified as containing coal tar
	Assess potential treatability alternatives	4	TCLP	4 Samples: 1 unsaturated sample from within the northeast pond area; 2 oily and/or tarry samples from above the groundwater in former processing area; and 1 oily and/or tarry sample from below the groundwater in the former processing area
	Assess site applicability of selected treatment and containment technologies	7	PAHs, BETX, Phenols, Arsenic, Cadmium, Lead, Mercury, Selenium, Cyanide	4 Untreated soil samples from contaminated areas and 3 treated soil samples
Groundwater Sampling	Refine groundwater quality characterization	19	pH, Temperature, Specific Conductance, Semivolatiles, Volatile Organic Compounds, Metals/Cyanide, Pesticides/PCBs	1st Round from Phase II monitoring wells
	Refine groundwater quality characterization	32	PAHs, VOCs, Phenols, Arsenic (total, +III, +V), Cadmium, Lead, Mercury, Selenium, Total Ammonia, Total Cyanide, Thiocyanate, and Weak Acid Dissociable Cyanide	2nd Round from all monitoring wells; 3 HydroPunch samples at bottom of sand aquifer
	Assess potential treatability alternatives	10	pH, Temperature, Specific Conductance, BOD/COD, Oil & Grease, Total Suspended Solids, Sulfate, Sulfide, Chloride, Acidity, Alkalinity, Total Hardness, Total Dissolved Solids, and Total Organic Carbon	1st Round from Monitoring Wells MW-6S, MW-6D, MW-7S, MW-7D, MW-9S, MW-9D, MW-10S, MW-10D, MW-12S, and MW-12D

TABLE 3.2-1 (Cont.)

PHASE II RI SAMPLING SUMMARY

SAMPLING ACTIVITY	OBJECTIVE	ESTIMATED NO. OF SAMPLES	ANALYTICAL PARAMETERS	RATIONALE FOR SAMPLE SELECTION
Groundwater Sampling (Cont.)	Evaluate potential effectiveness and cost of electrochemical precipitation for remedies involving groundwater pump-out and treatment	8	PAHs, BETX, Phenols, Arsenic (total, +III, +V), Cadmium, lead, Mercury, Selenium, Total Ammonia, Total Cyanide, Thiocyanate, and Weak Acid Dissociable Cyanide	3 Sets of influent and effluent samples to be collected during treatment of the water on-site; 2 sets of samples with upstream activated carbon; 1 set of samples with upstream precipitation
Surface Water Sampling	Evaluate potential site impacts on Waukegan Harbor and Lake Michigan	21	pH, Temperature, Specific Conductance, PAHs, VOCs, Phenols, Arsenic (total, +III, +V), Cadmium, Mercury, Selenium, Total Ammonia, Total Cyanide, Thiocyanate, Weak Acid Dissociable Cyanide, Total Suspended Solids, Oil and Grease, and BOD/COD	12 sampling locations: 1 in the slip, 4 in the Harbor, 7 in the lake; 2 samples at each location (as water depth allows): 1 taken from a depth of 2 feet below surface and 1 taken from a depth 1½ feet above bottom of water body.

PAH Polynuclear aromatic hydrocarbons listed in Table 2.4-8.
 BETX Benzene, ethyl benzene, toluene, xylenes.
 Phenols Phenolic compounds listed in Table 2.4-8.
 VOC Volatile organic compounds listed in Table 2.4-14.
 BOD Biochemical oxygen demand.
 COD Chemical oxygen demand.

Phase I Full-Scan Parameters: Inorganic parameters listed in Table 2.2-9; volatile organic parameters listed in Table 2.2-10; semivolatile organic compounds listed in Table 2.2-11; and pesticides and PCBs listed in Table 2.2-12.

TABLE 3.2-2

PHASE II SAMPLE AND ANALYSIS PROGRAM

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLE			QUALITY CONTROL SAMPLES ¹									MATRIX TOTAL ⁴
						FIELD DUPLICATE			FIELD BLANK			MS/MSD ^{2,3}			
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
Soil	Screening for Total Organic Vapors, Field Soil Classification, Field pH, and Field Screening for PAHs (to be performed on each soil sample)	CLP TCL Semivolatiles	12	1	12	2	1	2	-	-	-	1	1	1	14
		CLP TCL Volatile Organic Compounds	12	1	12	2	1	2	-	-	-	1	1	1	14
		CLP TCL Metals/Cyanide	12	1	12	2	1	2	-	-	-	1	1	1	14
		CLP TCL Pesticides/PCBs	12	1	12	2	1	2	-	-	-	1	1	1	14
		PAHs	168	1	168	17	1	17	-	-	-	9	1	9	185
		Phenols	168	1	168	17	1	17	-	-	-	9	1	9	185
		BETX	168	1	168	17	1	17	-	-	-	9	1	9	185
		Arsenic, Cadmium, Lead, Mercury, Selenium, and Cyanide	168	1	168	17	1	17	-	-	-	-	-	-	185
		Corrosivity & Reactivity	6	1	6	1	1	1	-	-	-	-	-	-	7
		Grain Size Distribution	6	1	6	-	-	-	-	-	-	-	-	-	6
		Atterberg Limits	3	1	3	-	-	-	-	-	-	-	-	-	3
		Porosity	6	1	6	-	-	-	-	-	-	-	-	-	6
		Total Organic Carbon	6	1	6	-	-	-	-	-	-	-	-	-	6
		Cation Exchange Capacity	6	1	6	-	-	-	-	-	-	-	-	-	6
		Vertical Permeability	3	1	3	-	-	-	-	-	-	-	-	-	3
		Gross Heating Value	3	1	3	-	-	-	-	-	-	-	-	-	3
		Flashpoint	3	1	3	-	-	-	-	-	-	-	-	-	3
		TCLP	4	1	4	-	-	-	-	-	-	-	-	-	4
		Oil and Grease	3	1	3	1	1	1	-	-	-	-	-	-	4

TABLE 3.2-2 (Cont.)
PHASE II SAMPLE AND ANALYSIS PROGRAM

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLE			QUALITY CONTROL SAMPLES ¹									MATRIX TOTAL ⁴
						FIELD DUPLICATE			FIELD BLANK			MS/MSD ^{2,3}			
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
Groundwater	pH, Temperature, Specific Conductance (to be measured at each monitoring point during each monitoring event)	CLP TCL Semivolatiles	19	1	19	2	1	2	2	1	2	1	1	1	23
		CLP TCL Volatile Organic Compounds	19	1	19	2	1	2	2	1	2	1	1	1	23
		CLP TCL Metals/Cyanide	19	1	19	2	1	2	2	1	2	1	1	1	23
		CLP TCL Pesticides/PCBs	19	1	19	2	1	2	2	1	2	1	1	1	23
		PAHs	40	1	40	4	1	4	4	1	4	2	1	2	48
		Phenols	40	1	40	4	1	4	4	1	4	2	1	2	48
		VOCs	40	1	40	4	1	4	4	1	4	2	1	2	48
		Arsenic (total, +III, +V), Cadmium, Lead, Mercury, Selenium, Total Cyanide, Thiocyanate, Weak Acid Dissociable Cyanide ⁵	40	1	40	4	1	4	4	1	4	2	1	2	48
		Total Ammonia	40	1	40	4	1	4	4	1	4	2	1	2	48
		Total Suspended Solids	10	1	10	1	1	1	-	-	-	-	-	-	11
		Oil and Grease	10	1	10	1	1	1	-	-	-	-	-	-	11
		BOD/COD	10	1	10	1	1	1	-	-	-	-	-	-	11
		Sulfate	10	1	10	1	1	1	-	-	-	-	-	-	11
		Sulfide	10	1	10	1	1	1	-	-	-	-	-	-	11
		Chloride	10	1	10	1	1	1	-	-	-	-	-	-	11
		Alkalinity	10	1	10	1	1	1	-	-	-	-	-	-	11
		Acidity	10	1	10	1	1	1	-	-	-	-	-	-	11
		Total Hardness	10	1	10	1	1	1	-	-	-	-	-	-	11
		Total Dissolved Solids	10	1	10	1	1	1	-	-	-	-	-	-	11
		Total Organic Carbon	10	1	10	1	1	1	-	-	-	-	-	-	11

TABLE 3.2-2 (Cont.)
PHASE II SAMPLE AND ANALYSIS PROGRAM

SAMPLE MATRIX	FIELD PARAMETERS	LABORATORY PARAMETERS	INVESTIGATIVE SAMPLE			QUALITY CONTROL SAMPLES ¹									MATRIX TOTAL ⁴
						FIELD DUPLICATE			FIELD BLANK			MS/MSD ^{2,3}			
			NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	NO.	FREQ.	TOTAL	
Surface Water	pH, Temperature, Specific Conductance, Depth to Bottom of Water Body (to be measured at each sample location during each monitoring event)	PAHs	21	1	21	3	1	3	3	1	3	2	1	2	27
		Phenols	21	1	21	3	1	3	3	1	3	2	1	2	27
		VOCs	21	1	21	3	1	3	3	1	3	2	1	2	27
		Arsenic (total, +III, +V), Cadmium, Lead, Mercury, Selenium, Total Cyanide, Thiocyanate, Weak Acid Dissociable Cyanide	21	1	21	3	1	3	3	1	3	2	1	2	27
		Total Ammonia	21	1	21	3	1	3	3	1	3	2	1	2	27
		Total Suspended Solids	21	1	21	3	1	3	-	-	-	-	-	-	24
		Oil and Grease	21	1	21	3	1	3	-	-	-	-	-	-	24
	BOD/COD	21	1	21	3	1	3	-	-	-	-	-	-	24	

¹The field quality control samples also include trip blanks, which are required for VOA water and air samples. One trip blank, which consists of the 40-ml glass vials for water samples and one blank cartridge for air samples, is shipped with each shipping cooler of VOA samples.

²Matrix spike/matrix spike duplicate (MS/MSD) are required for organic analysis. Water samples designated for MS/MSD analysis will be collected with extra sample volumes, at a frequency of one per group of 20 or fewer investigative samples. Triple the normal sample volumes will be collected for VOAs, extractable organics, pesticides, and PCBs.

³For inorganic analysis, double the normal sample volumes will be collected for inorganic MS/MSD samples.

⁴The number of samples to be collected for MS/MSD are not included in the matrix total. The number of trip blank samples is also excluded from the matrix total.

⁵These samples for metals will be filtered in the field.

PAH Polynuclear aromatic hydrocarbons listed in Table 2.4-8.

BETX Benzene, ethyl benzene, toluene, xylenes.

Phenols Phenolic compounds listed in Table 2.4-8.

VOC Volatile organic compounds listed in Table 2.4-14.

BOD Biochemical oxygen demand.

COD Chemical oxygen demand.

TABLE 3.2-3

SAMPLE CONTAINERS, PRESERVATION AND TECHNICAL HOLDING TIMES

PARAMETER	CONTAINER	PRESERVATION	MAXIMUM TECHNICAL HOLDING TIME	MINIMUM VOLUME
WATER				
Semivolatiles: PAHs (including low level), Acid Extractables	Amber glass, teflon- lined cap	Cool, 4°C	7 days to extraction; 40 days after extraction	2,000 ml
Cyanide (total and amenable)	High density polyethylene or glass	Cool, 4°C, NaOH to pH>12	14 days	1,800 ml
Thiocyanate	High density polyethylene or glass	Cool, 4°C NaOH to pH>12	14 days	1,800 ml
Weak Acid Dissociable Cyanide	High density polyethylene or glass	Cool, 4°C, NaOH to pH>12	14 days	1,800 ml
Metals (except Hg)	High density polyethylene or glass	HNO ₃ to pH<2	6 months	1,000 ml
Mercury	High density polyethylene or glass	HNO ₃ to pH<2	28 days	500 ml
Oil and Grease	Glass	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days	2,000 ml
Total Suspended Solids	High density polyethylene or glass	Cool, 4°C	7 days	200 ml
Pesticides/PCBs	Amber glass, teflon- lined cap	Cool, 4°C	7 days extraction; 40 days after extraction	2,000 ml
Chemical Oxygen Demand	High density polyethylene or glass	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days	100 ml
Biochemical Oxygen Demand	High density polyethylene or glass	Cool, 4°C	48 hours	1,000 ml
Volatile Organic Compounds	Glass, teflon-lined septum	Cool, 4°C, HCl to pH<2	14 days	40 mlx2
Total Ammonia	High density polyethylene or glass	Cool, 4°C, H ₂ SO ₄ to pH<2	28 days	500 ml

TABLE 3.2-3 (Cont.)

SAMPLE CONTAINERS, PRESERVATION AND TECHNICAL HOLDING TIMES

PARAMETER	CONTAINER	PRESERVATION	MAXIMUM TECHNICAL HOLDING TIME	MINIMUM VOLUME
Alkalinity	High density polyethylene or glass	Cool, 4°C	14 days	250 ml
Acidity	High density polyethylene or glass	Cool, 4°C	14 days	250 ml
Arsenic III and V	High density polyethylene or glass	HCL to pH<2	48 hours	500 ml
Chloride	High density polyethylene or glass	--	28 days	250 ml
pH	High density polyethylene or glass	Cool, 4°C	immediately	100 ml
Sulfate	High density polyethylene or glass	Cool, 4°C	28 days	500 ml
Sulfide	High density polyethylene or glass	Cool, 4°C, add zinc acetate and NaOH to pH>9	7 days	500 ml
Total Hardness	High density polyethylene or glass	HNO ₃ or H ₂ SO ₄ to pH<2	6 months	250 ml
Total Dissolved Solids	High density polyethylene or glass	Cool, 4°C	7 days	250 ml
Total Organic Carbon	High density polyethylene or glass	Cool, 4°C H ₂ SO ₄ to pH<2	28 days	250 ml

TABLE 3.2-3 (Cont.)

SAMPLE CONTAINERS, PRESERVATION AND TECHNICAL HOLDING TIMES

PARAMETER	CONTAINER	PRESERVATION	MAXIMUM TECHNICAL HOLDING TIME	MINIMUM VOLUME
SOIL				
Semivolatiles: PAHs, Acid Extractables, Pesticides/PCBs	Glass, teflon-lined cap	Cool, 4°C	14 days to extraction; 40 days after extraction	8 oz.
Cyanide	High density polyethylene or glass	Cool, 4°C	12 days	8 oz.
Metals (except mercury)	High density polyethylene or glass	Cool, 4°C	180 days	8 oz.
Mercury	High density polyethylene or glass	Cool, 4°C	26 days	8 oz.
Volatiles	Glass, teflon	Cool, 4°C	14 days	2 2-oz. jars
TOC	Glass	Cool, 4°C	28 days	8 oz.
Flashpoint	Glass	Cool, 4°C	not defined	8 oz.
Reactivity	Glass	Cool, 4°C	as soon as possible	8 oz.
Oil and Grease	Glass	Cool, 4°C	28 days	8 oz.
Cation exchange capacity	Glass	--	--	4 oz.

TABLE 3.6-1

ESTIMATED DURATION OF PROJECT TASKS
REVISION 2

ACTIVITY	START	TASKS	START DATE	TASK DURATION (WEEKS)	CUMULATIVE DURATION ^{1,2} (WEEK NUMBER)	COMPLETION DATE
Phase I Field Investigation	Work Plan Approved and Site Access Obtained	Investigation Support	2/26/92 ²	8	8	4/23/92
		Test Trenching	3/9/92	6	7	4/17/92
		Surficial Soil/Background Sampling	3/2/92	4	4	3/28/92
		Monitoring Wells/Soil Borings	3/9/92	6	7	4/17/92
		Groundwater Sampling/Slug Tests	4/6/92	1	6	4/10/92
		Ecological Survey	5/27/92	5	18	6/30/92
		Sample Analysis/Validation	3/92	18	22	7/92
		Data Evaluation/Modeling	3/92	18	22	7/92
		Phase I Tech Memo	5/28/92	13	26	8/28/92
		Revised ARARs/PRG Tech Memo	7/16/92	5	27	9/5/92
		EPA Review	8/30/92	23	50	2/8/93
		EPA Review Meeting	3/5/93	0	53	3/5/93
		Phase I Tech Memo Revisions	3/6/93	4	59	4/13/93
		EPA Review and Approval	4/14/93	4	63	5/14/93
Phase II Field Investigation	Phase I Tech Memo Approved	Investigation Support	9/30/92	42	76	8/14/93
		Soil Borings	6/13/93	5	72	7/17/93
		Monitoring Wells	7/18/93	4	76	8/14/93
		Pumping Test	8/8/93	1	76	8/14/93
		Groundwater Sampling #1	8/8/93	1	76	8/14/93
		Sample Analysis/Validation #1	7/18/93	11	83	10/2/93
		Groundwater Sampling #2	9/26/93	1	83	10/2/93
		Sample Analysis/Validation #2	10/3/93	4	87	10/30/93
		Data Evaluation	7/18/93	21	93	12/11/93
		Preliminary Characterization Summary	11/7/93	5	93	12/11/93
		EPA Review and Approval	12/12/93	2	95	12/25/93

¹Accounts for concurrent tasks.²Based on full site access having been granted on February 26, 1992.

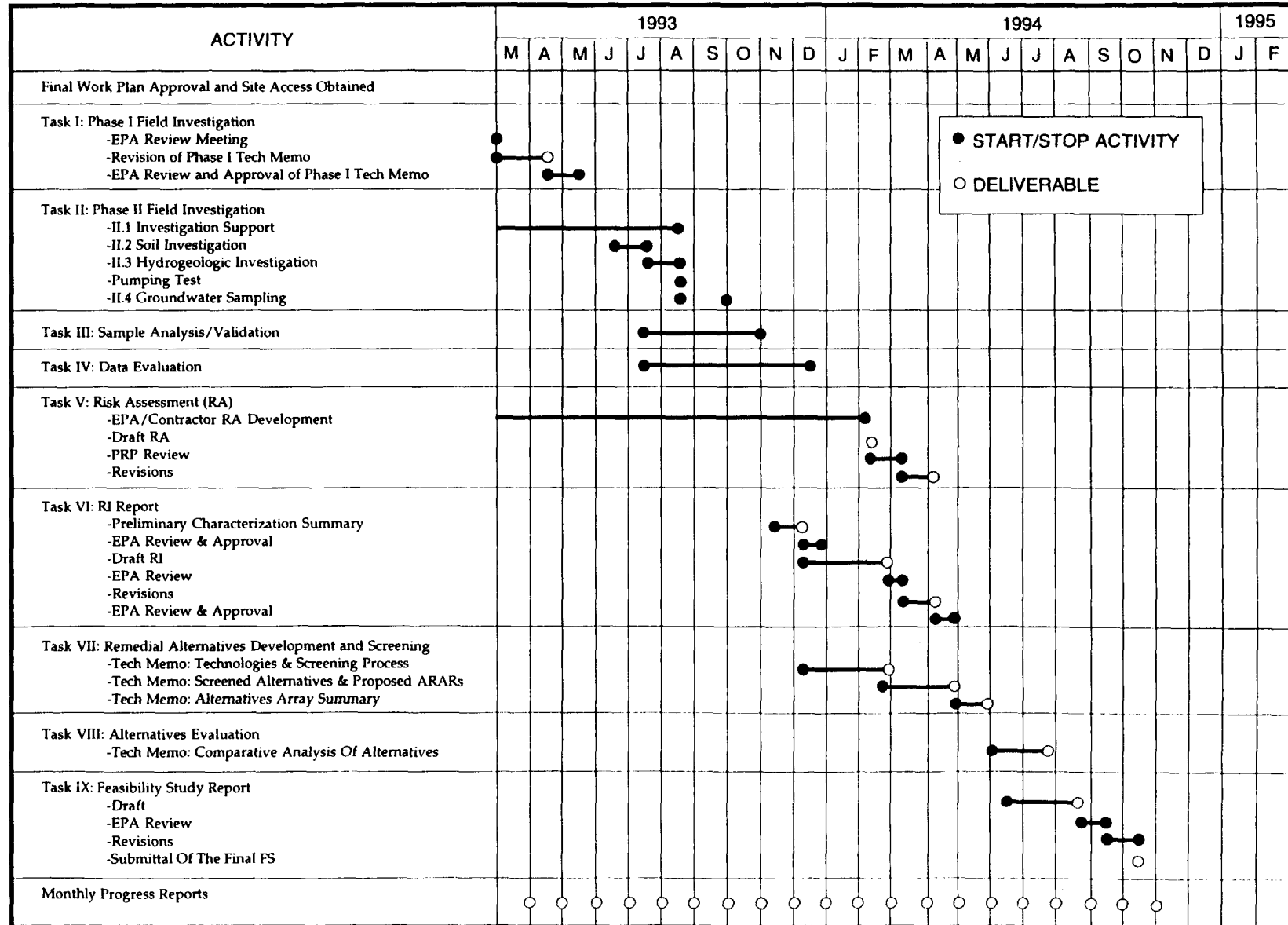
TABLE 3.6-1 (continued)
ESTIMATED DURATION OF PROJECT TASKS
REVISION 2

ACTIVITY	START	TASKS	START DATE	TASK DURATION (WEEKS)	CUMULATIVE DURATION ^{1,2} (WEEK NUMBER)	COMPLETION DATE
Risk Assessment		Risk Assessment	2/26/92	101	101	2/5/94
RI Report, Remedial Alternatives Development and Screening, Risk Assessment Review	Preliminary Characterization Summary Approved	Prepare Draft RI Report	12/5/93	12	104	2/26/94
		Prepare Tech Memo on Technologies and Screening Process	12/5/93	12	104	2/26/94
		PRP Review of Risk Assessment	2/6/94	4	105	3/5/94
		EPA Review of Draft RI	2/27/94	2	106	3/12/94
		EPA Risk Assessment Revisions	3/6/94	4	109	4/2/94
		Revisions to Draft RI	3/13/94	4	110	4/9/94
		EPA Review and Approval of Revised RI	3/13/94	2	112	4/23/94
		Prepare Tech Memo on Screened Alternatives and Proposed ARARS	2/20/94	9	112	4/23/94
Alternatives Evaluation, FS Report	EPA Risk Assessment Completed	Prepare Tech Memo on Alternatives Array Summary	4/24/94	5	117	5/28/94
		Prepare Tech Memo on Comparative Analysis of Alternatives	5/29/94	8	125	7/23/94
		Prepare Draft FS Report	6/12/94	10	130	8/27/94
		EPA Review	8/28/94	2	132	9/10/94
		Revisions to Draft FS/ Submittal of Final FS	9/11/94	5	137	10/15/94
PROJECT TOTAL:					137 weeks (32 months)	

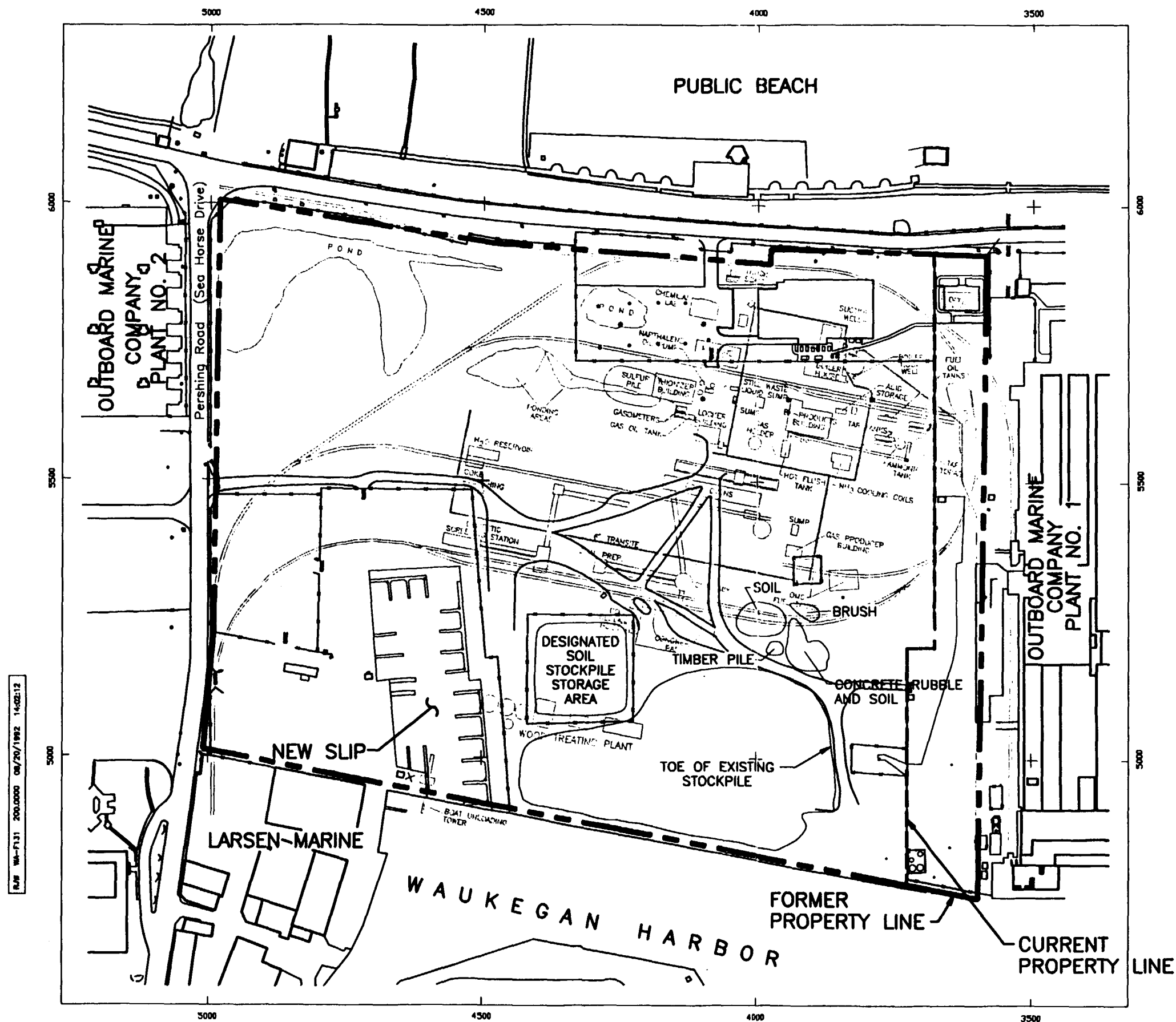
¹Accounts for concurrent tasks.

²Based on full site access having been granted on February 26, 1992.

TABLE 3.6-2
ESTIMATED REMAINING PROJECT SCHEDULE, REVISION 2



Figures



Base Map and locations of existing facilities provided by OMC.

Approximate location of Wood Treating Plant determined from USACE Map, 1908, and Sanborn Fire Insurance Map, 1917.

Locations of Coke Plant Facilities from aerial photographs and Sanborn Fire Insurance Maps.

- - Utility Pole
- ⊙ - Light Pole
- ◇ - Fire Hydrant
- ◆ - Traffic Signal
- - Post or Object

Figure 1.3-1
WAUKEGAN MANUFACTURED GAS AND COKE PLANT SITE

SDMS US EPA REGION V

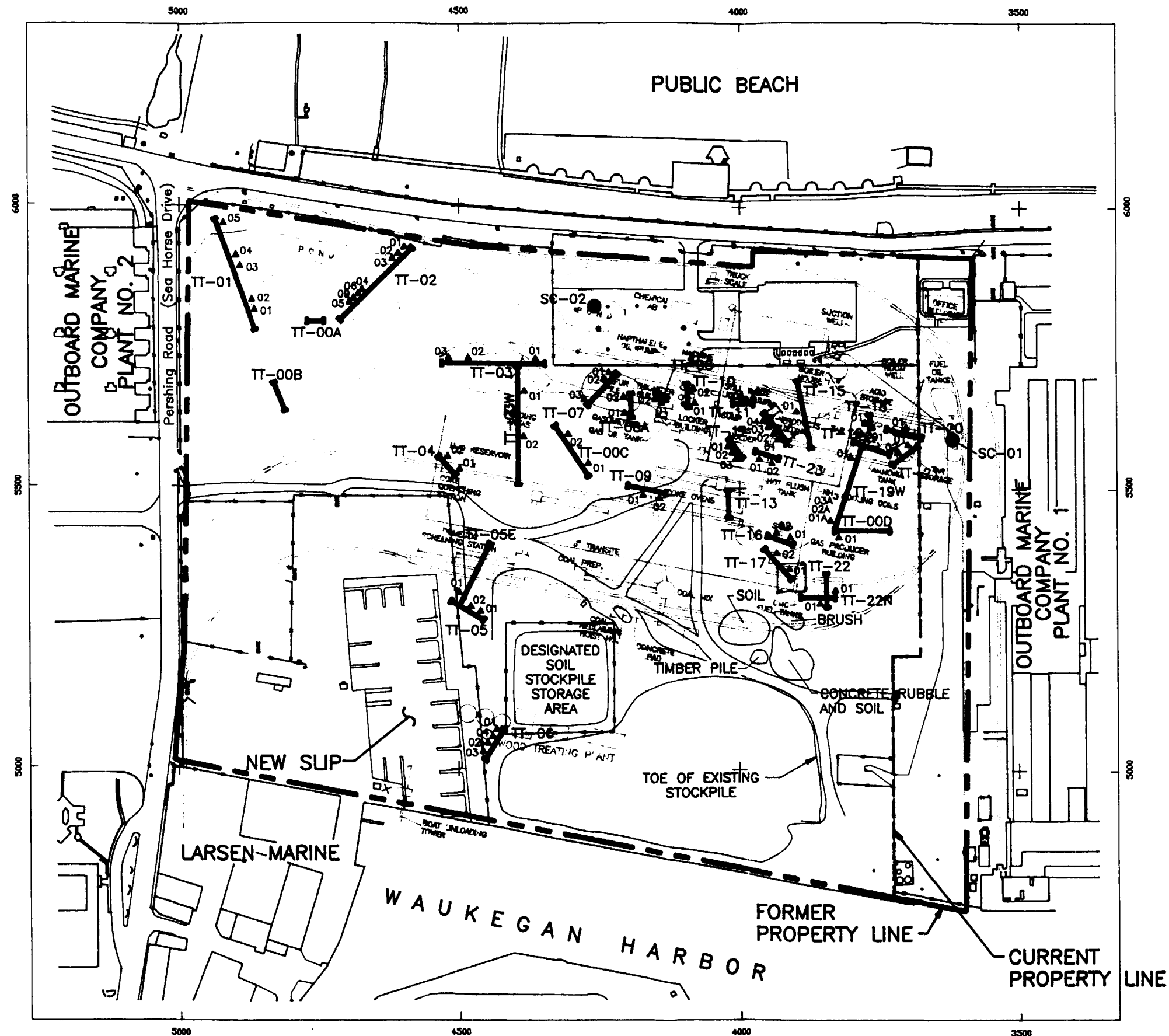
COLOR-RESOLUTION - 2

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COMMENT(S)	

Randy Wilson, Barr Engineering C:\RUM\1349-003\FIGS\WK-F221 200.0000 04/02/1993 08:31:45



Base Map and locations of existing facilities provided by OMC.

Approximate location of Wood Treating Plant determined from USACE Map, 1908, and Sanborn Fire Insurance Map, 1917.

Locations of Coke Plant Facilities from aerial photographs and Sanborn Fire Insurance Maps.

- — Surficial Soil Sample Location
- — Test Trench Location
- ▲01 — Test Trench Sample Location
- ⊗ — Utility Pole
- ☆ — Light Pole
- ⬠ — Fire Hydrant
- ⬠ — Traffic Signal
- — Post or Object

Figure 2.2-1
POTENTIAL SOURCE AREA INVESTIGATION
TEST TRENCH AND SURFICIAL SOIL
SAMPLE LOCATIONS

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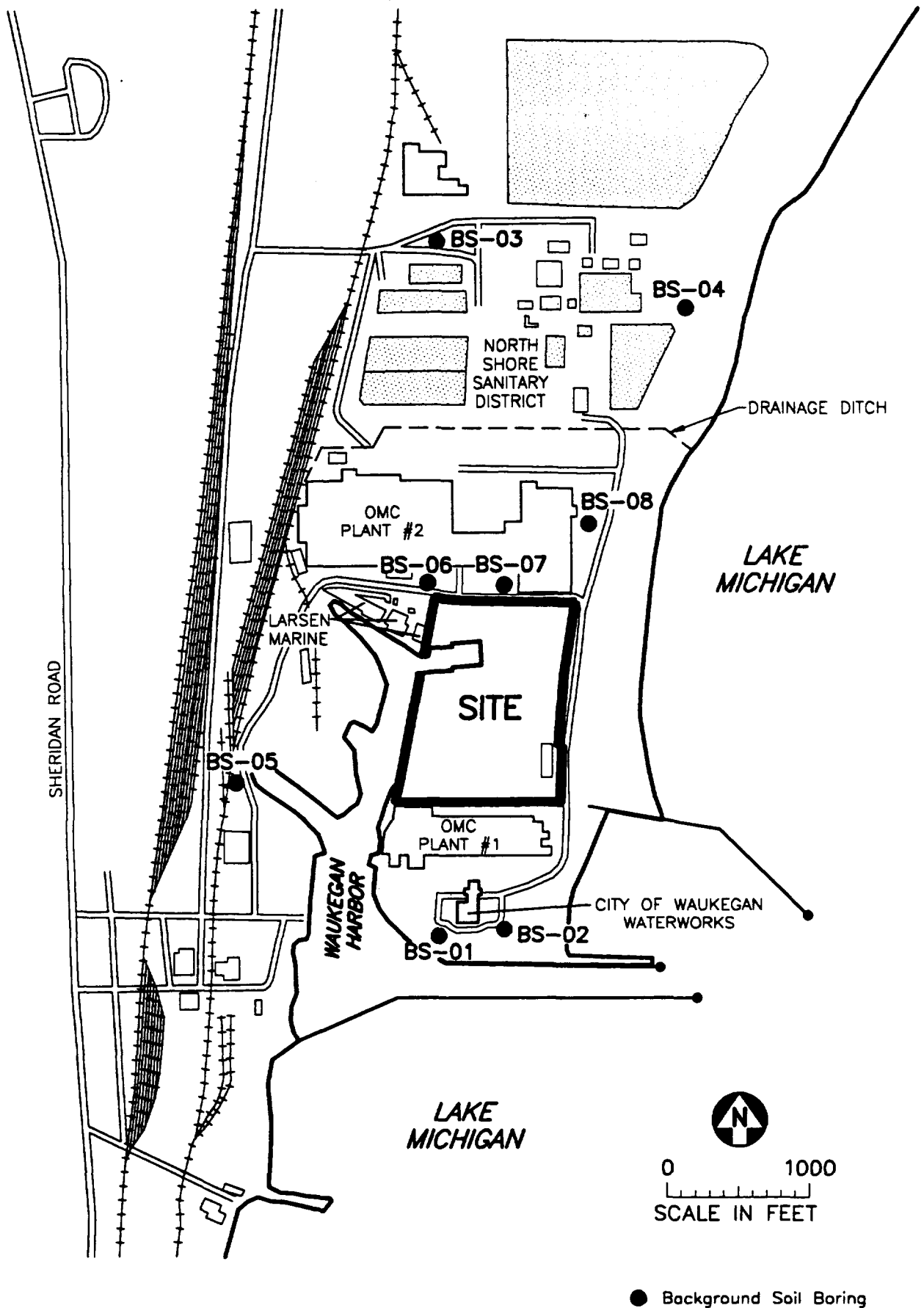
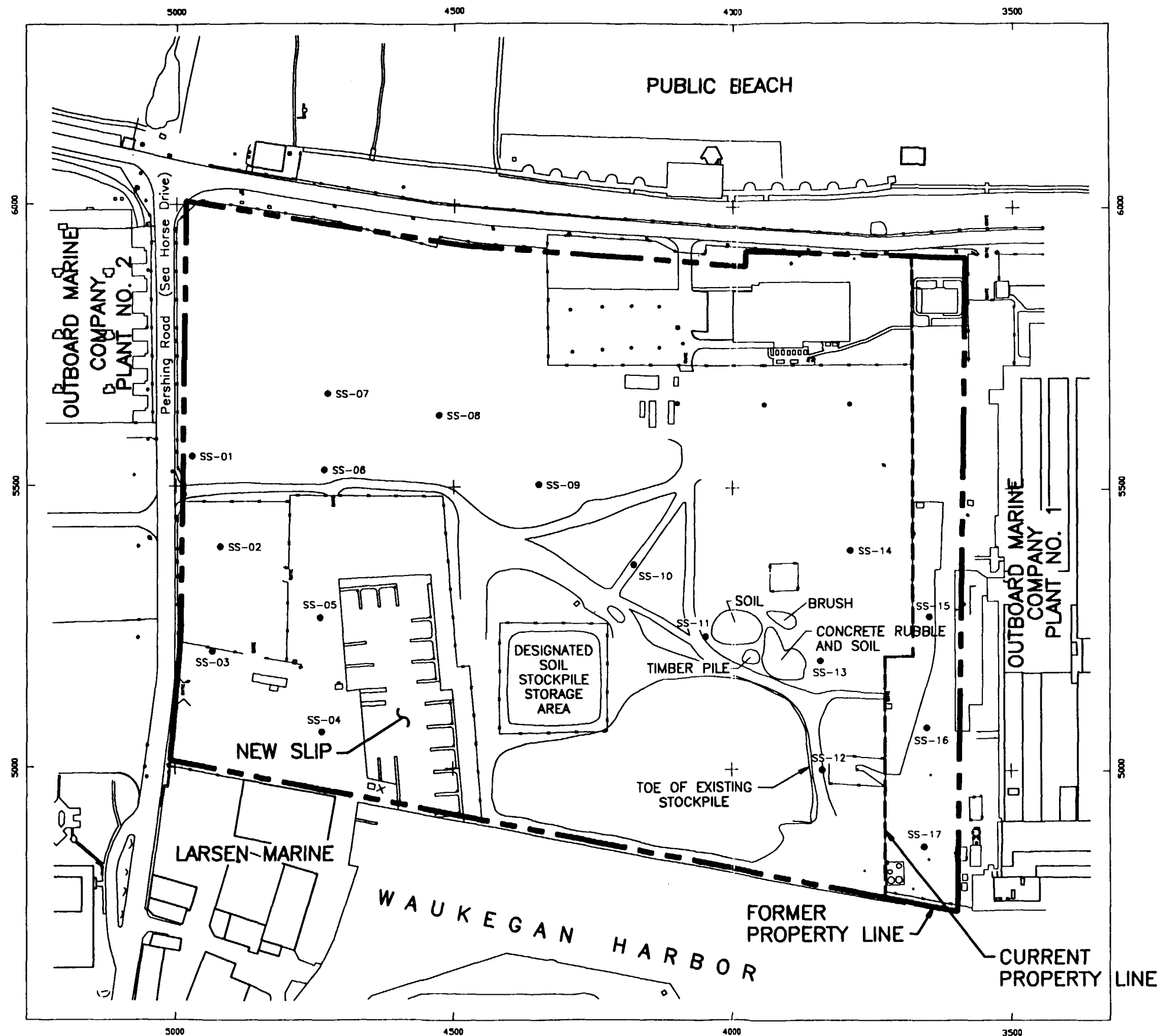


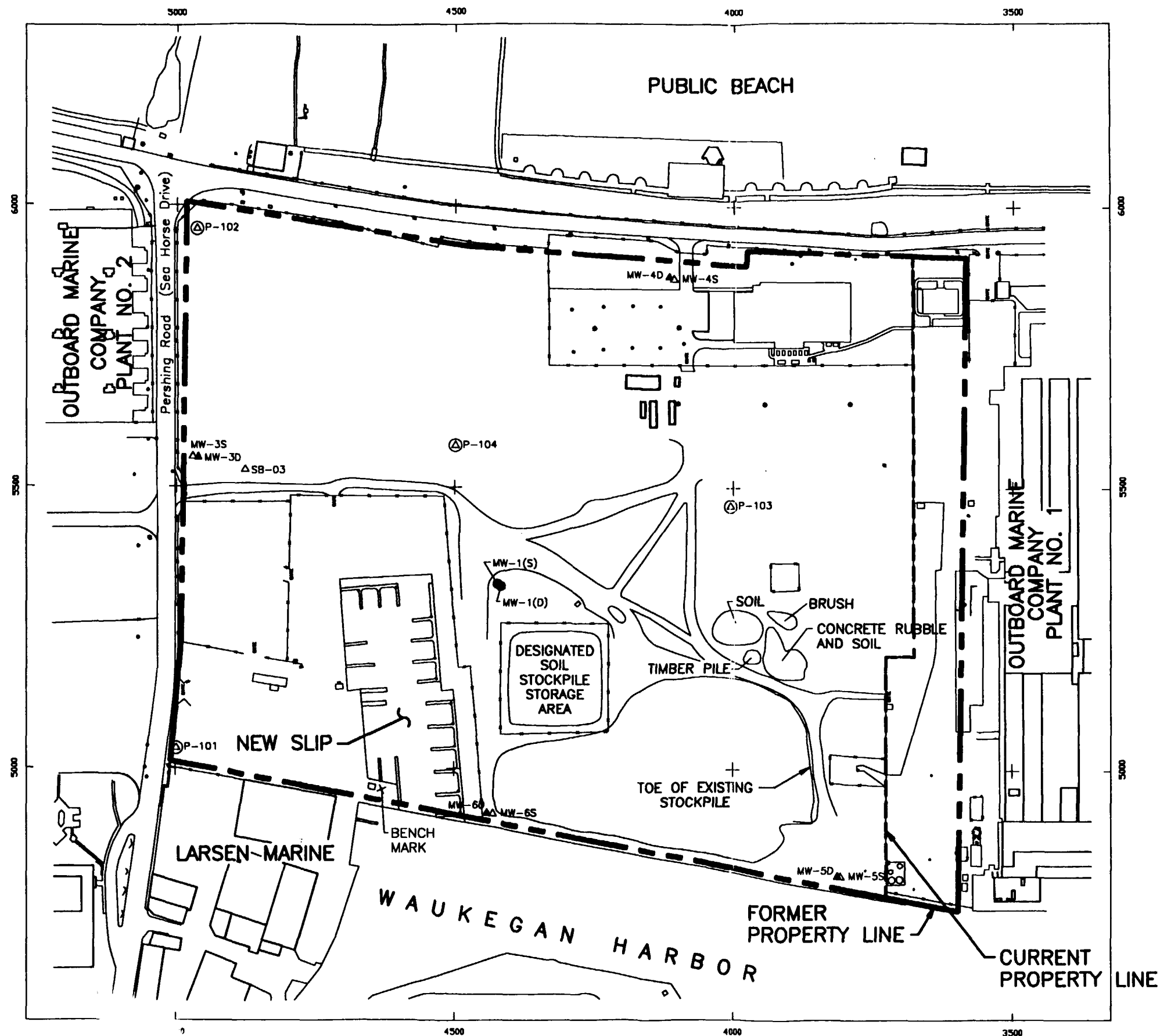
Figure 2.2-2
BACKGROUND SOIL
SAMPLE LOCATIONS

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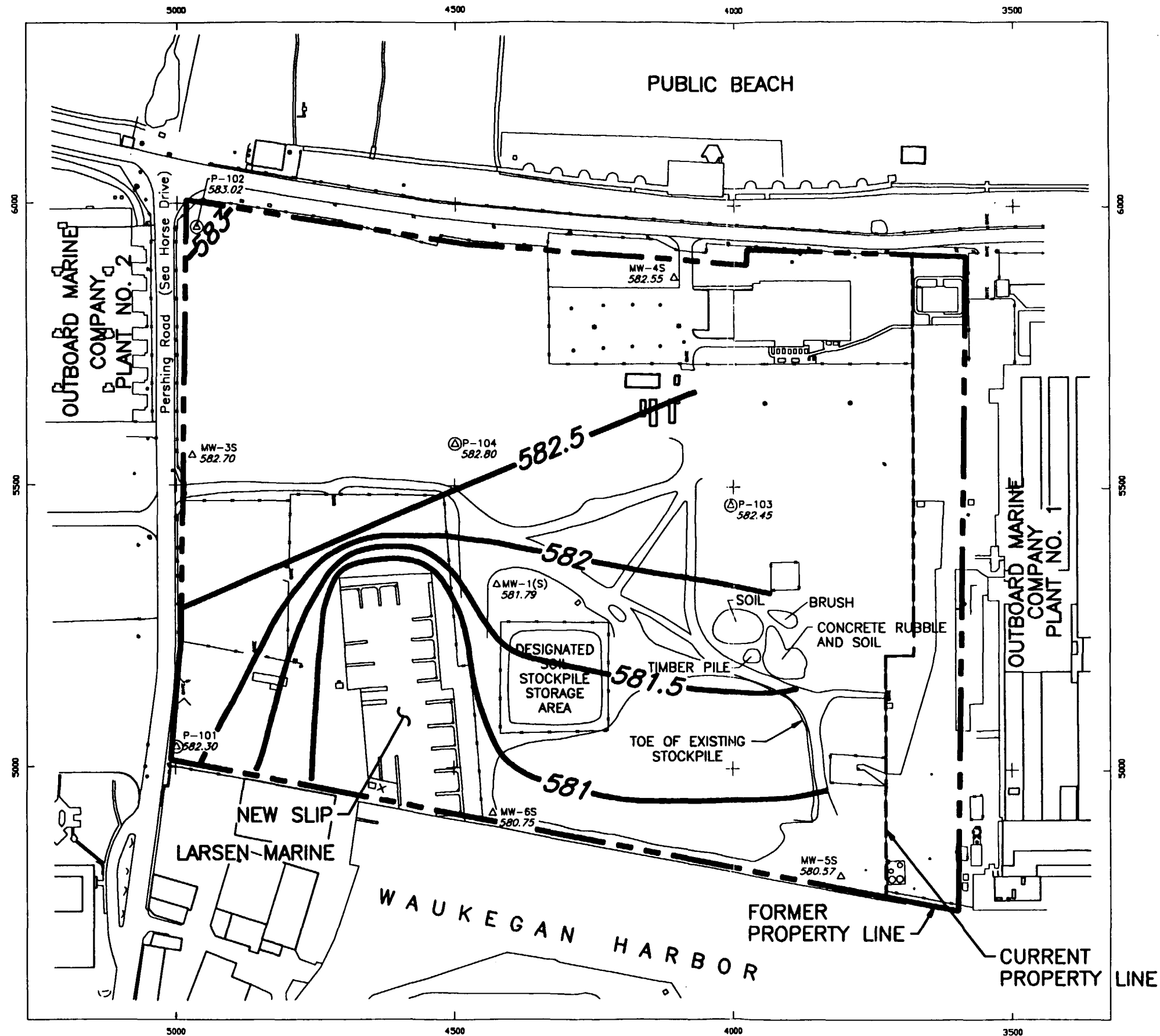
- - Utility Pole
- ⊙ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- - Surficial Soil Sample Location

Figure 2.2-3
SURFICIAL SOIL SAMPLE
LOCATIONS



- ⊗ - Utility Pole
- ⊛ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ▲ - Pilot Boring/Deep Monitoring Well
- ⊕ - Piezometer
- - Existing Monitoring Well

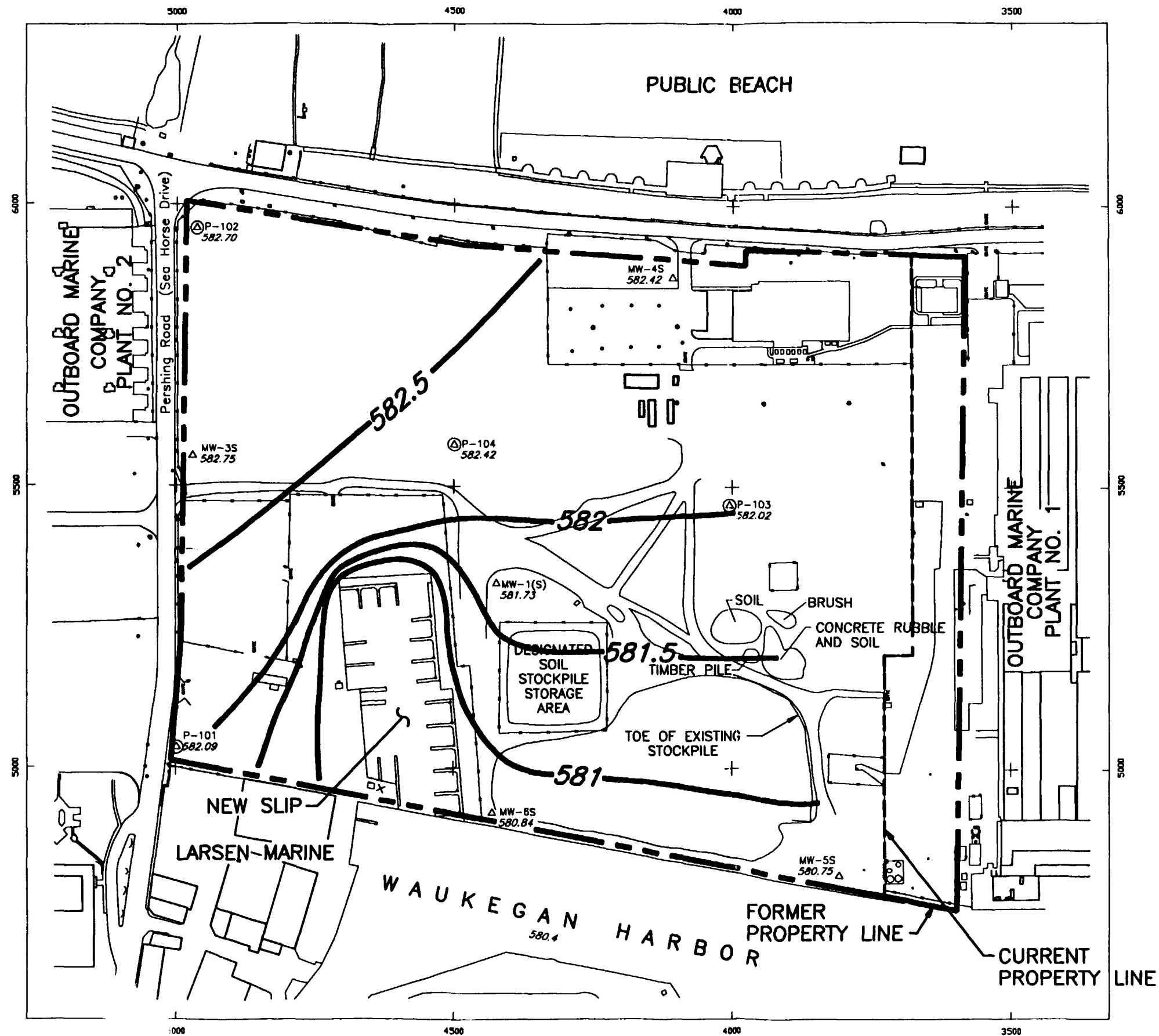
Figure 2.2-4
PILOT BORING, PIEZOMETER, AND
MONITORING WELL LOCATIONS



0 200
SCALE IN FEET

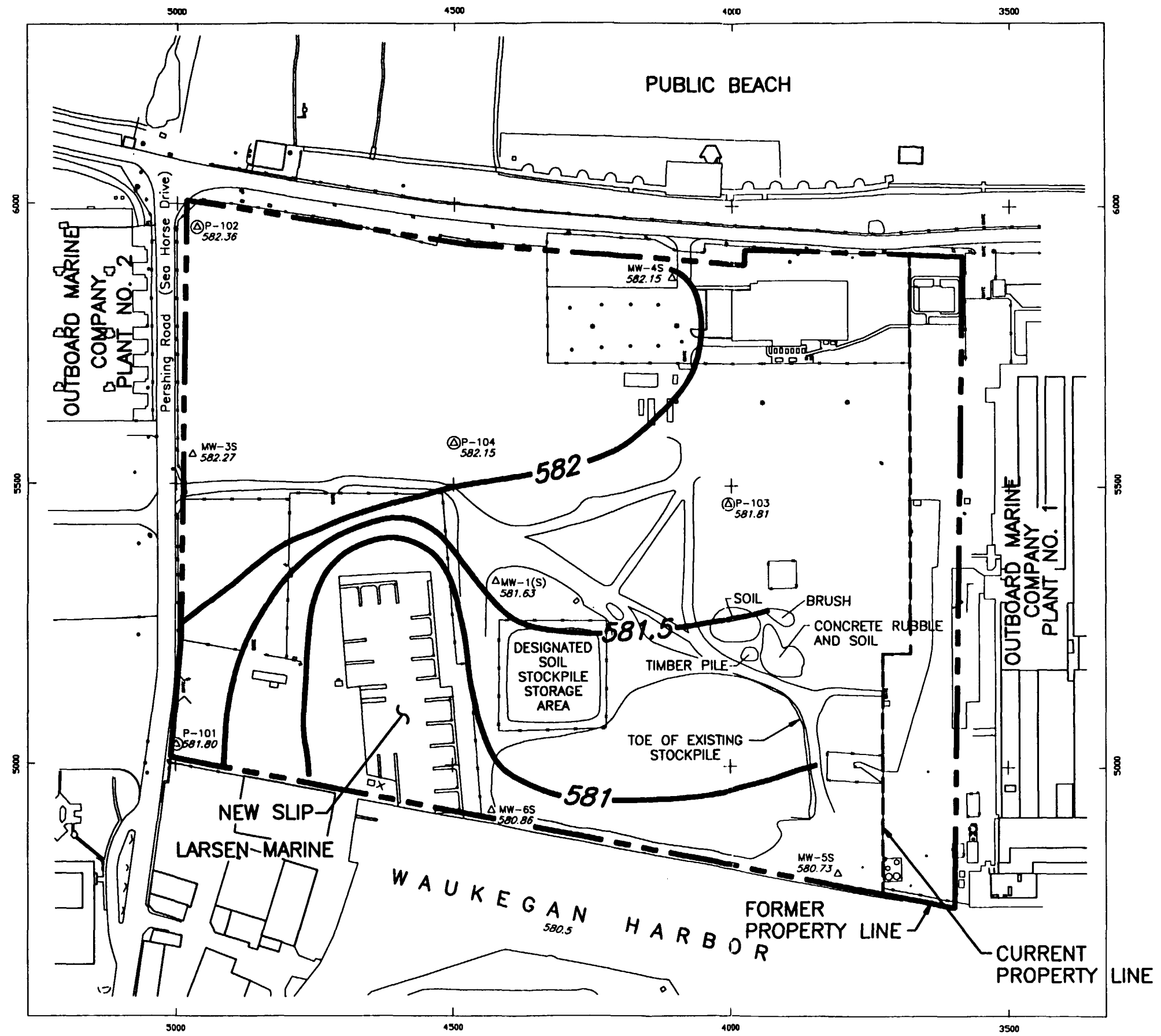
- ⊙ - Utility Pole
- ⊙ - Light Pole
- ⊙ - Fire Hydrant
- ⊙ - Traffic Signal
- ⊙ - Post or Object
- △ - Water Table Monitoring Well
- ⊙ - Piezometer

Figure 2.2-5
WATER TABLE ELEVATION CONTOURS
April 7, 1992



- ⊙ - Utility Pole
- ⊙ - Light Pole
- ⊙ - Fire Hydrant
- ⊙ - Traffic Signal
- ⊙ - Post or Object
- Δ - Water Table Monitoring Well
- ⊙ - Piezometer

Figure 2.2-6
WATER TABLE ELEVATION CONTOURS
April 15, 1992



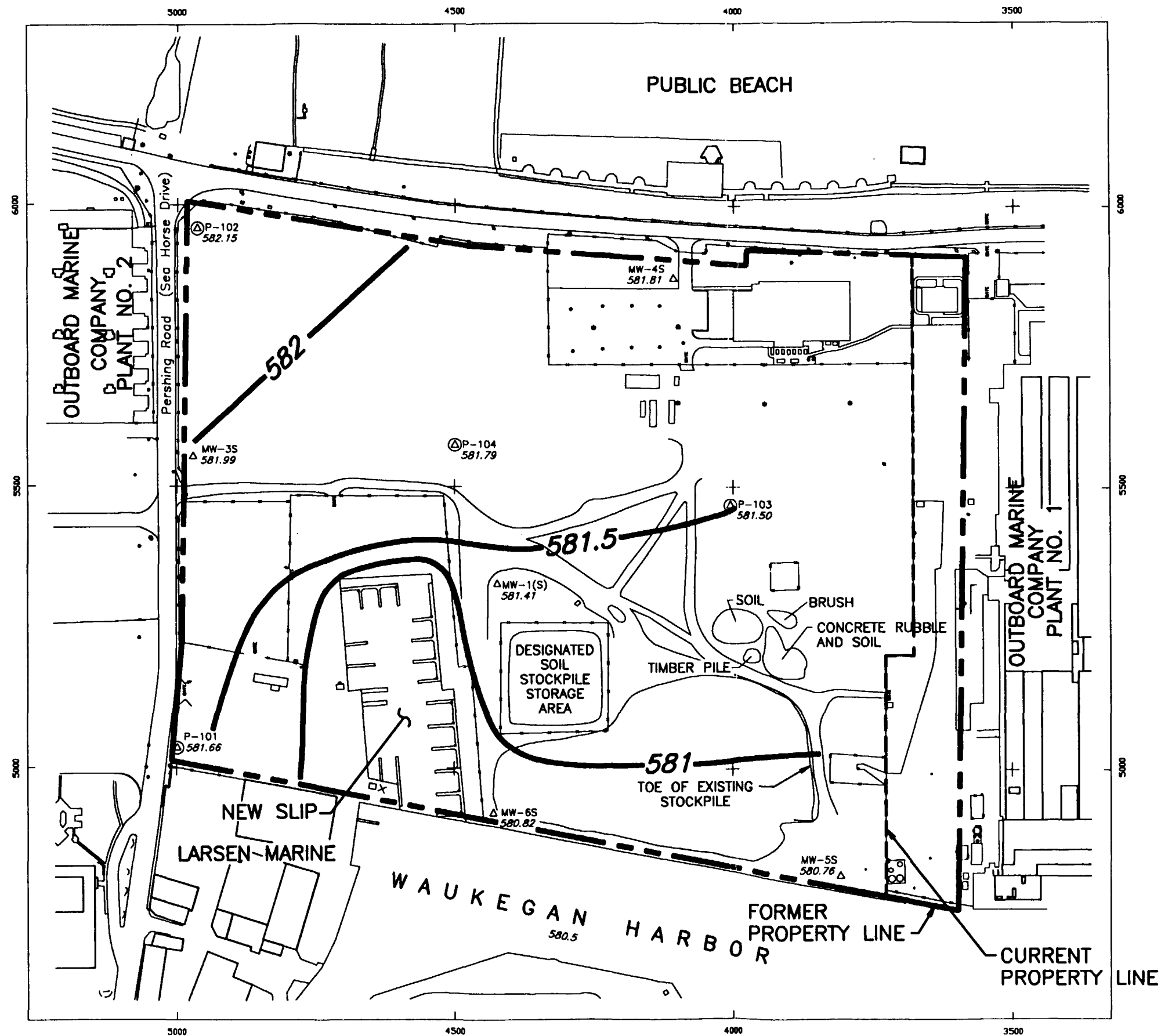
0 200
SCALE IN FEET

- ⊙ - Utility Pole
- ⊛ - Light Pole
- ⬢ - Fire Hydrant
- ⬢ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ⊙ - Piezometer

Figure 2.2-7
WATER TABLE ELEVATION CONTOURS
May 7, 1992

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RAW WA-F228 200.0000 08/20/1992 14:12:31

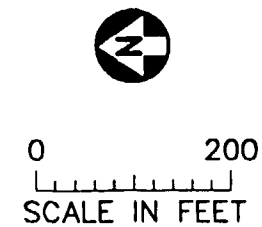
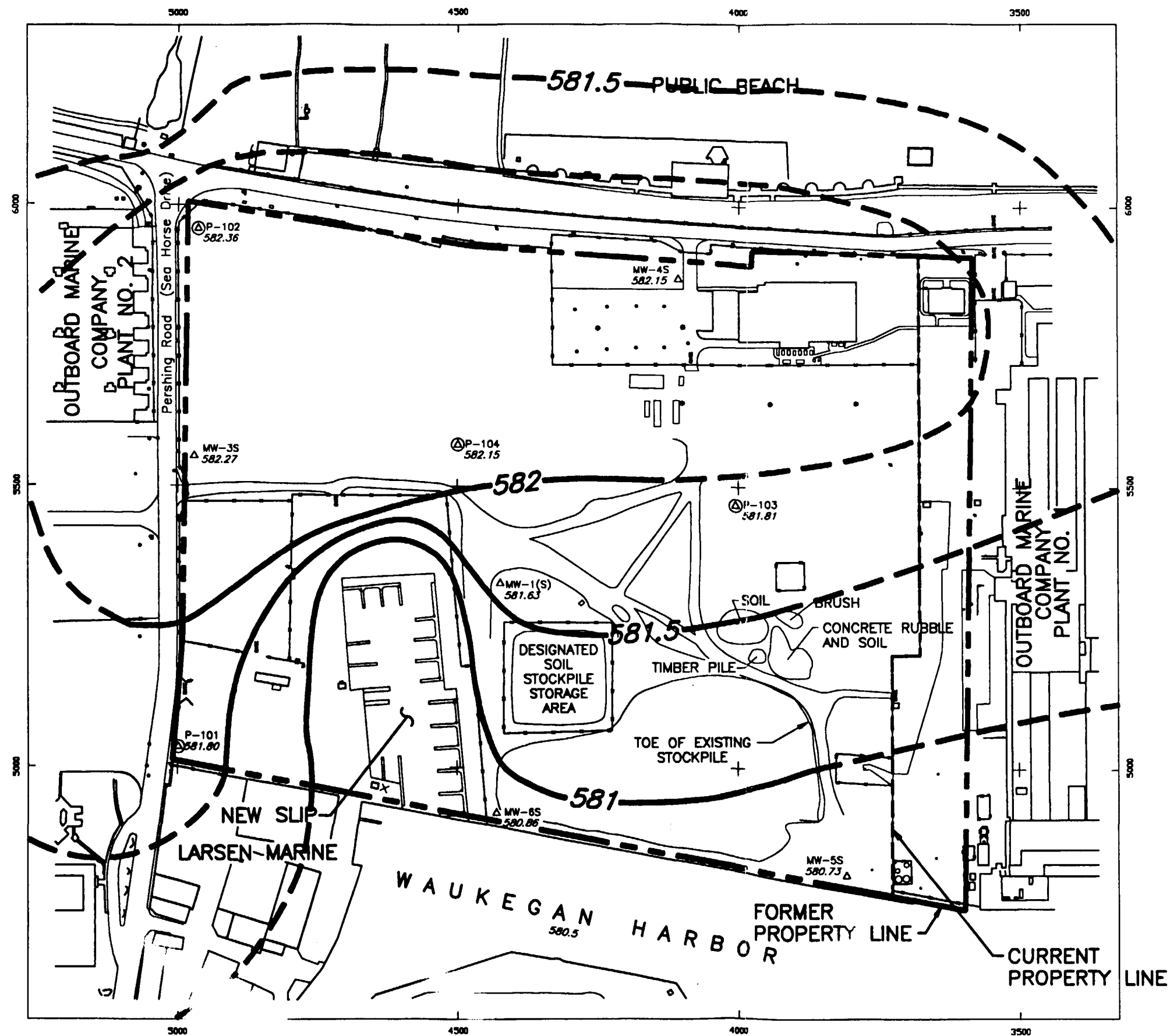


0 200
SCALE IN FEET

- - Utility Pole
- ⊙ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ⊙ - Piezometer

Figure 2.2-8
WATER TABLE ELEVATION CONTOURS
May 27, 1992

Randy Wilson, Barr Engineering C:\R\W\1348-003\FIG5\WK-F229 200.0000 04/01/1993 12:54:52



- ⊙ - Utility Pole
- ⊛ - Light Pole
- ⬢ - Fire Hydrant
- ⬢ - Traffic Signal
- ⊙ - Post or Object
- Δ - Water Table Monitoring Well
- ⊙ - Piezometer

Figure 2.2-9
WATER TABLE ELEVATION CONTOURS
CONCEPTUAL INTERPRETATION
May 7, 1992

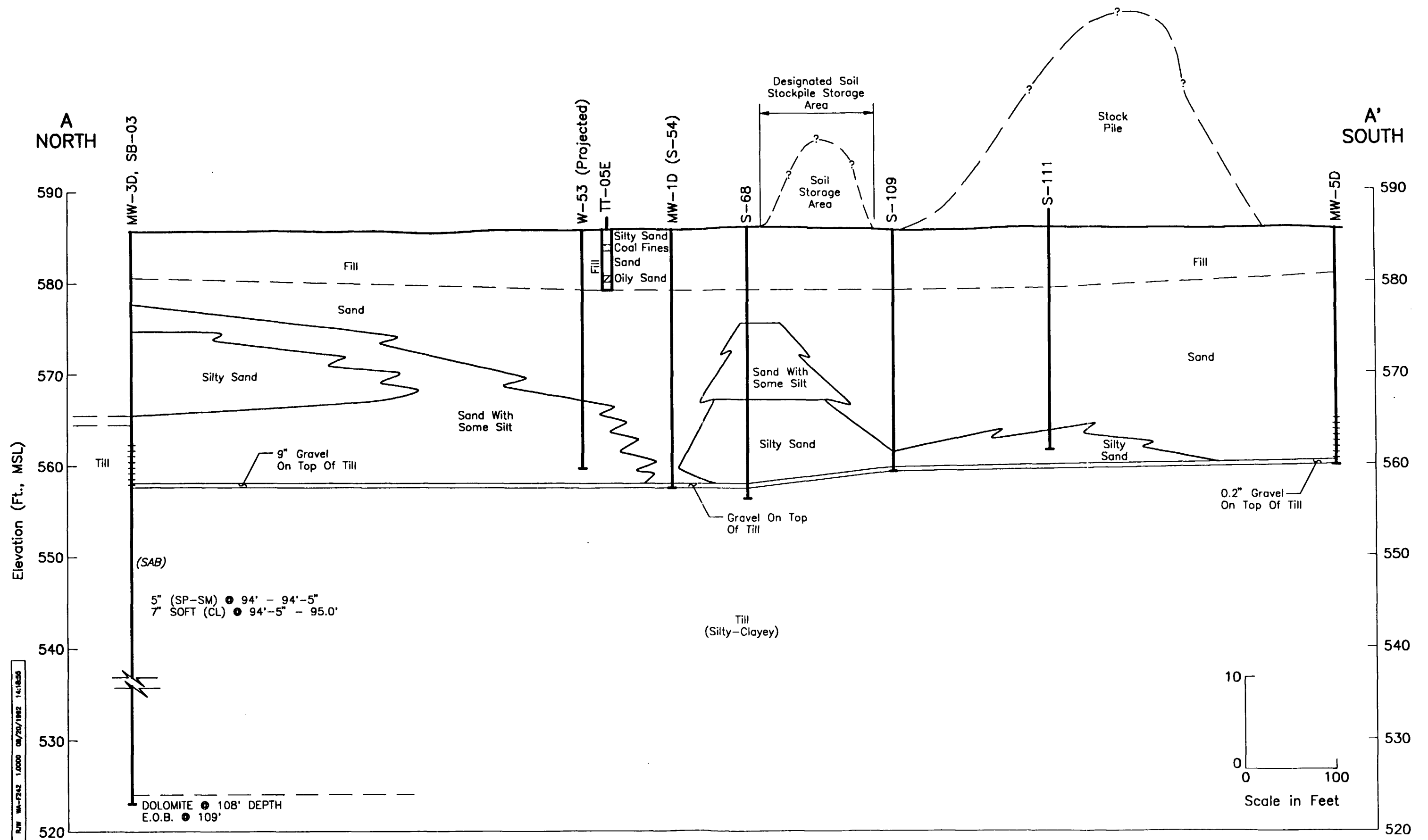
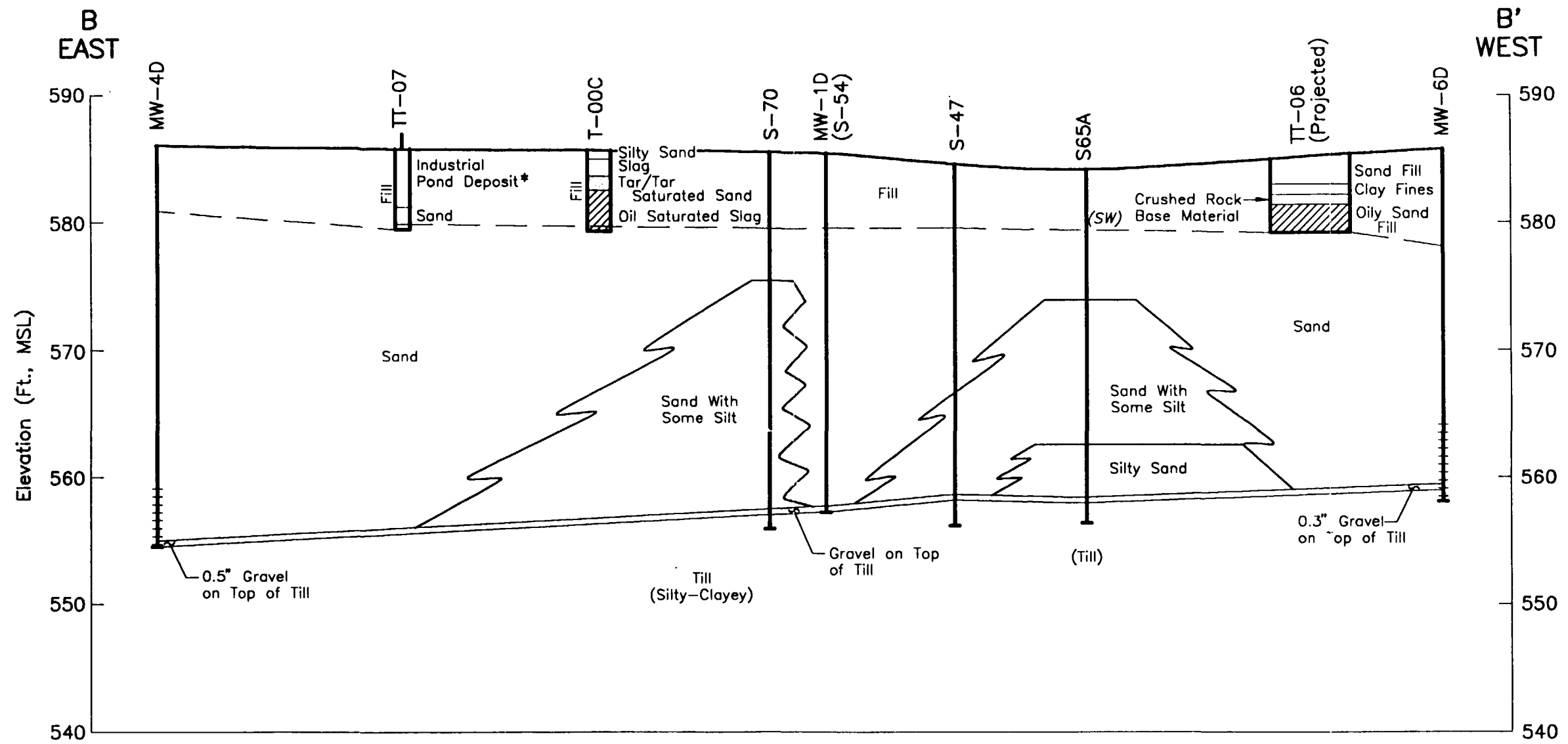


Figure 2.4-2
CROSS SECTION A-A'
NSG-WCP



* Interbedded Thin Black and White Laminations

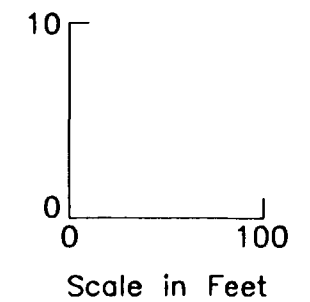


Figure 2.4-3
CROSS SECTION B-B'
NSG-WCP

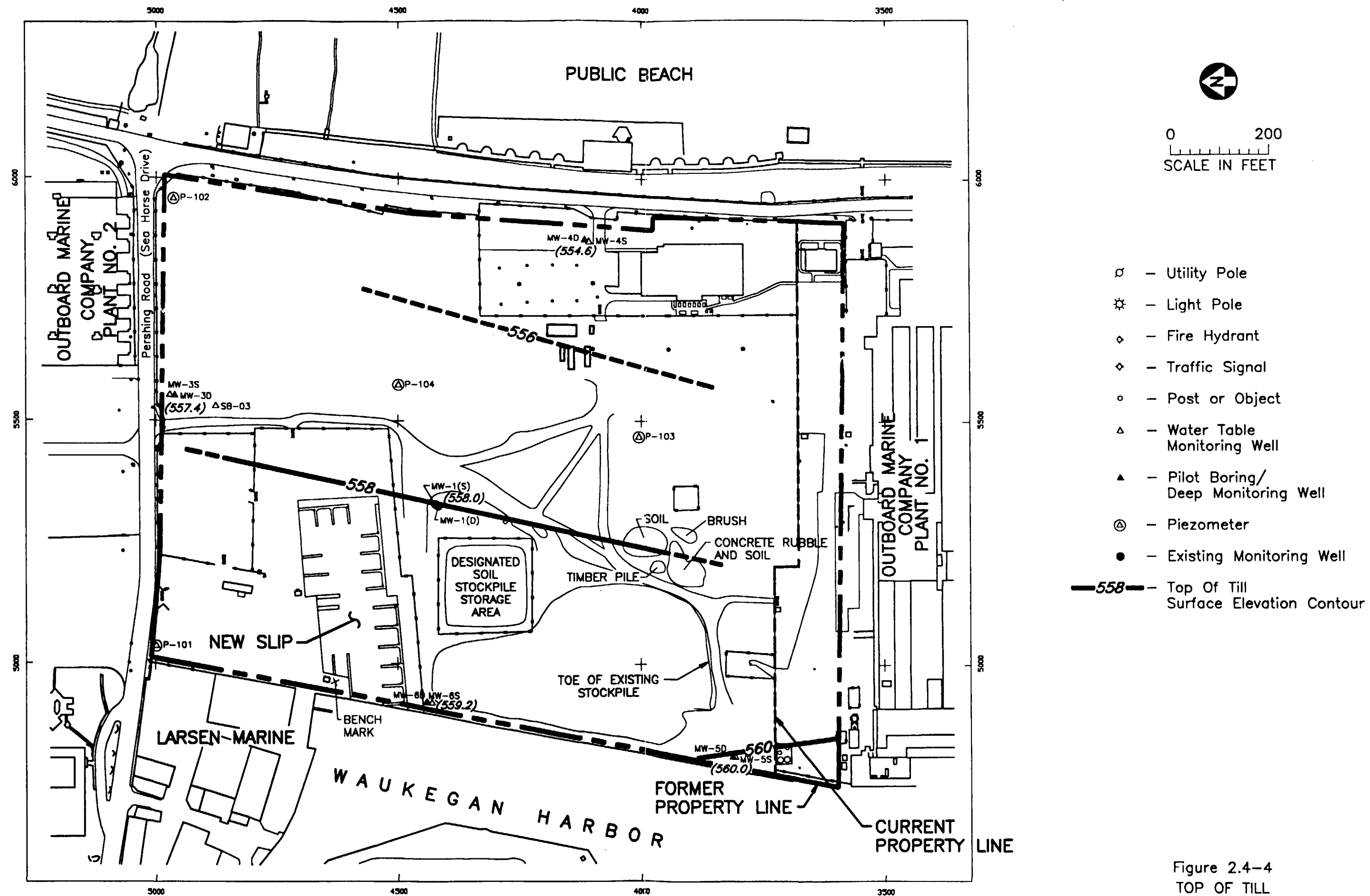


Figure 2.4-4
TOP OF TILL
SURFACE ELEVATION MAP

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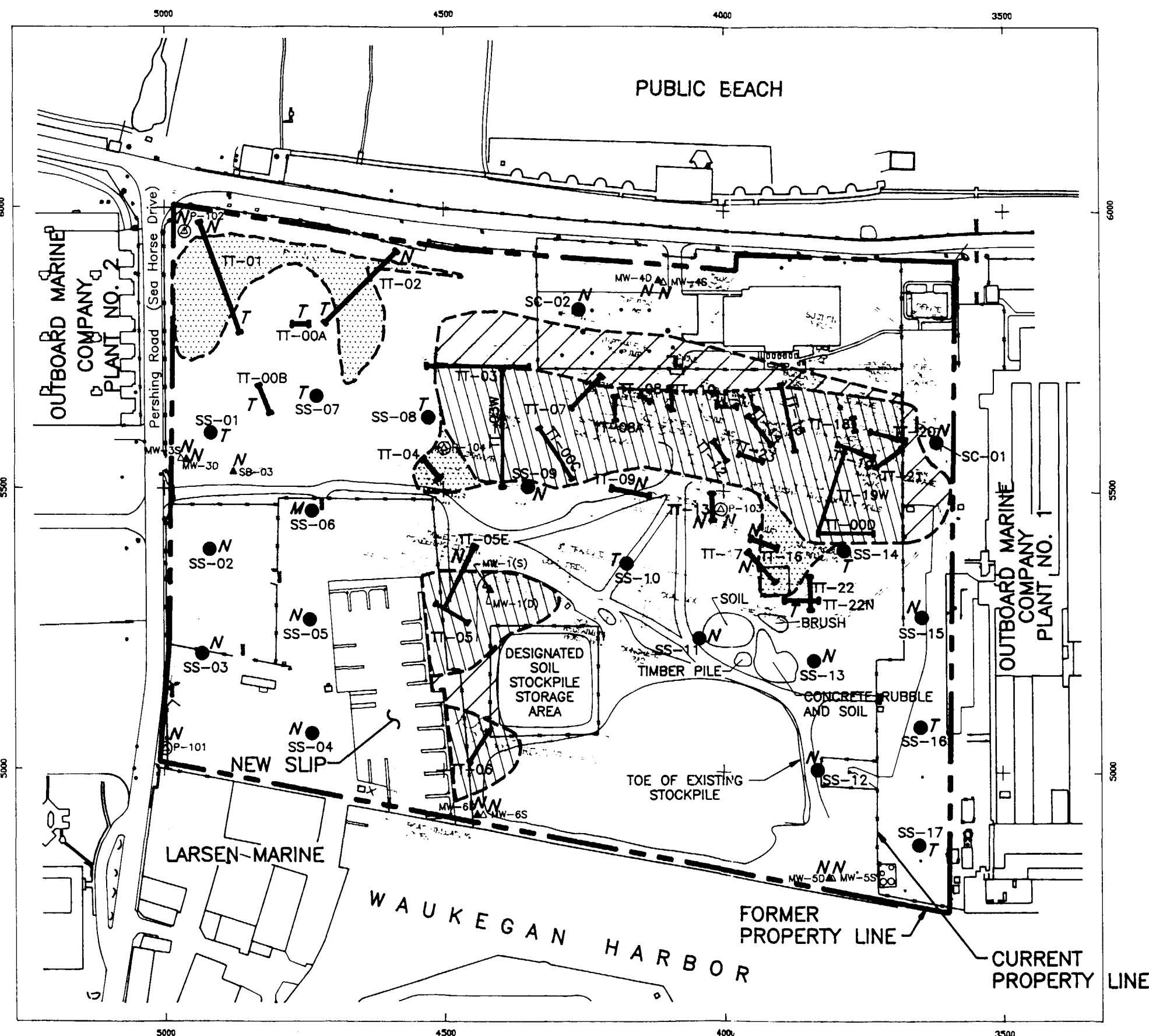
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SCALE IN FEET

Base Map and locations of existing facilities provided by OMC.

Approximate location of Wood Treating Plant determined from USACE Map, 1908, and Sanborn Fire Insurance Map, 1917.

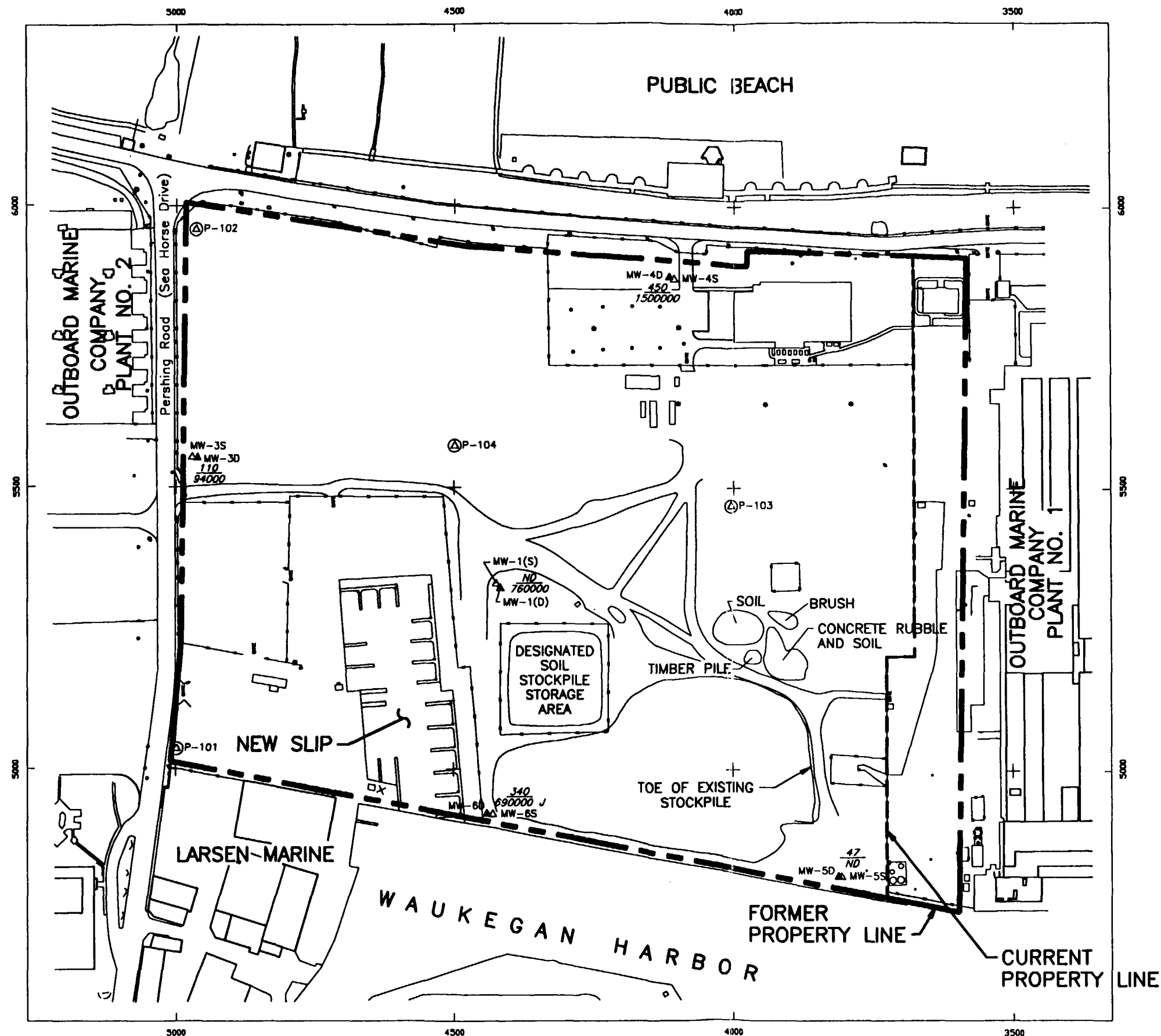
Locations of Coke Plant Facilities from aerial photographs and Sanborn Fire Insurance Maps.

- - Surficial Soil Sample Location
- △ - Water Table Monitoring Well
- ▲ - Pilot Boring/Deep Monitoring Well
- ⊙ - Piezometer
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- - Oil in Trench
- - Tar and Oil in Trench
- - No Tar or Oil in Trench
- - - Estimated Lateral Extent of Contaminated Soil (Based on Oil Sheen Test Results)
- ▨ - Area of Limited Data, Limits of Oil Sheen Not Defined
- ▨ - Area of Heavy Oil Sheen on Field Soil Samples
- ▨ - Area of Moderate Oil Sheen on Field Soil Samples
- N - Sample Location With No Oil Sheen On Field Soil Samples
- M - Sample Location With Moderate Oil Sheen On Field Soil Samples
- T - Sample Location With Trace Oil Sheen On Field Soil Samples



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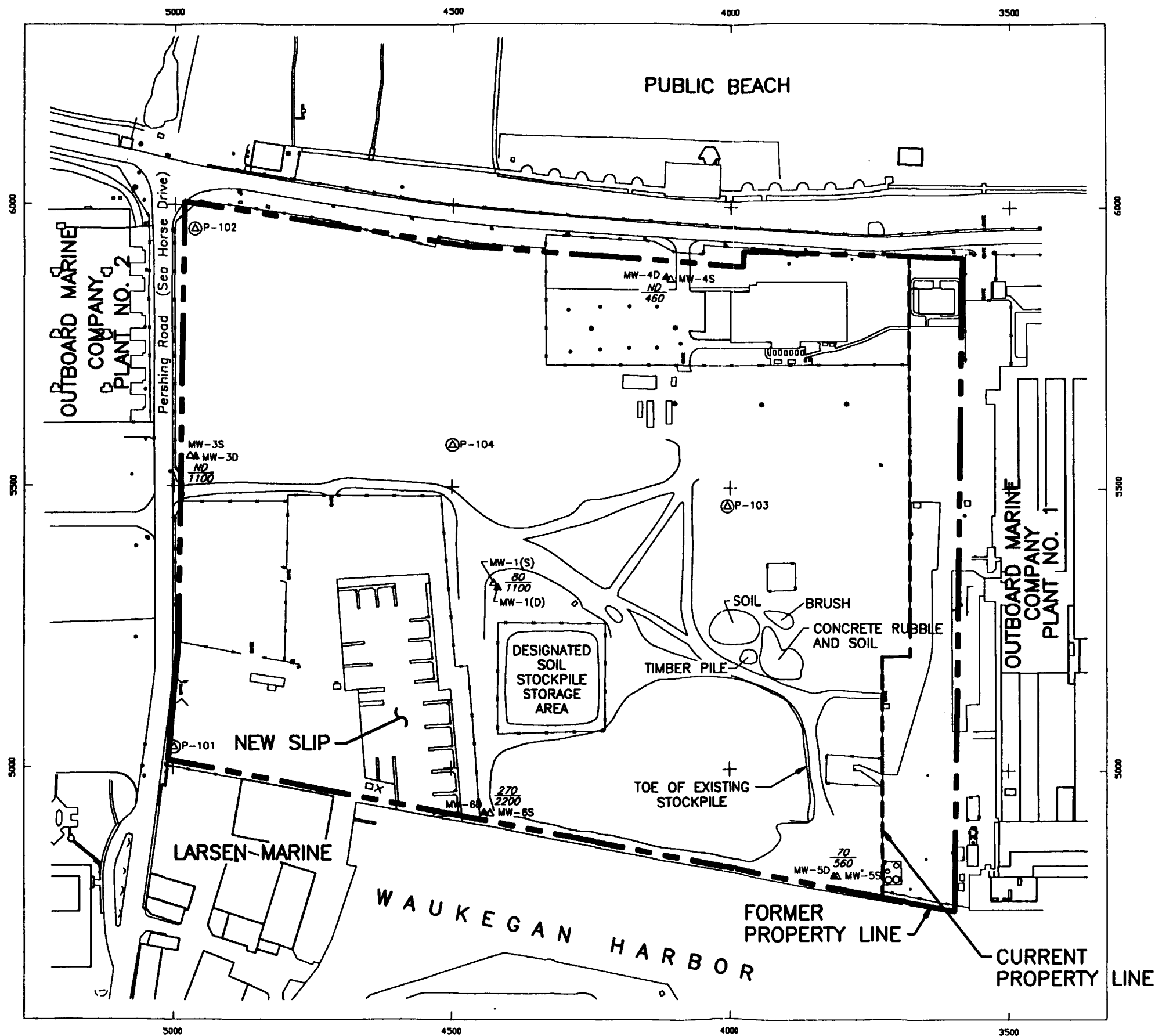
Figure 2.4-5
CONTAMINANT DISTRIBUTION
BASED ON FIELD SCREENING RESULTS



0 200
SCALE IN FEET

- - Utility Pole
- ☆ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ▲ - Deep Monitoring Well
- ⊙ - Piezometer
- 655 2421000
Concentration in the sample from the shallow well, ug/L
- Concentration in the sample from the deep well, ug/L
- J - Associated Value is an Estimate
- ND - None Detected

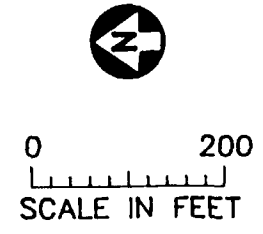
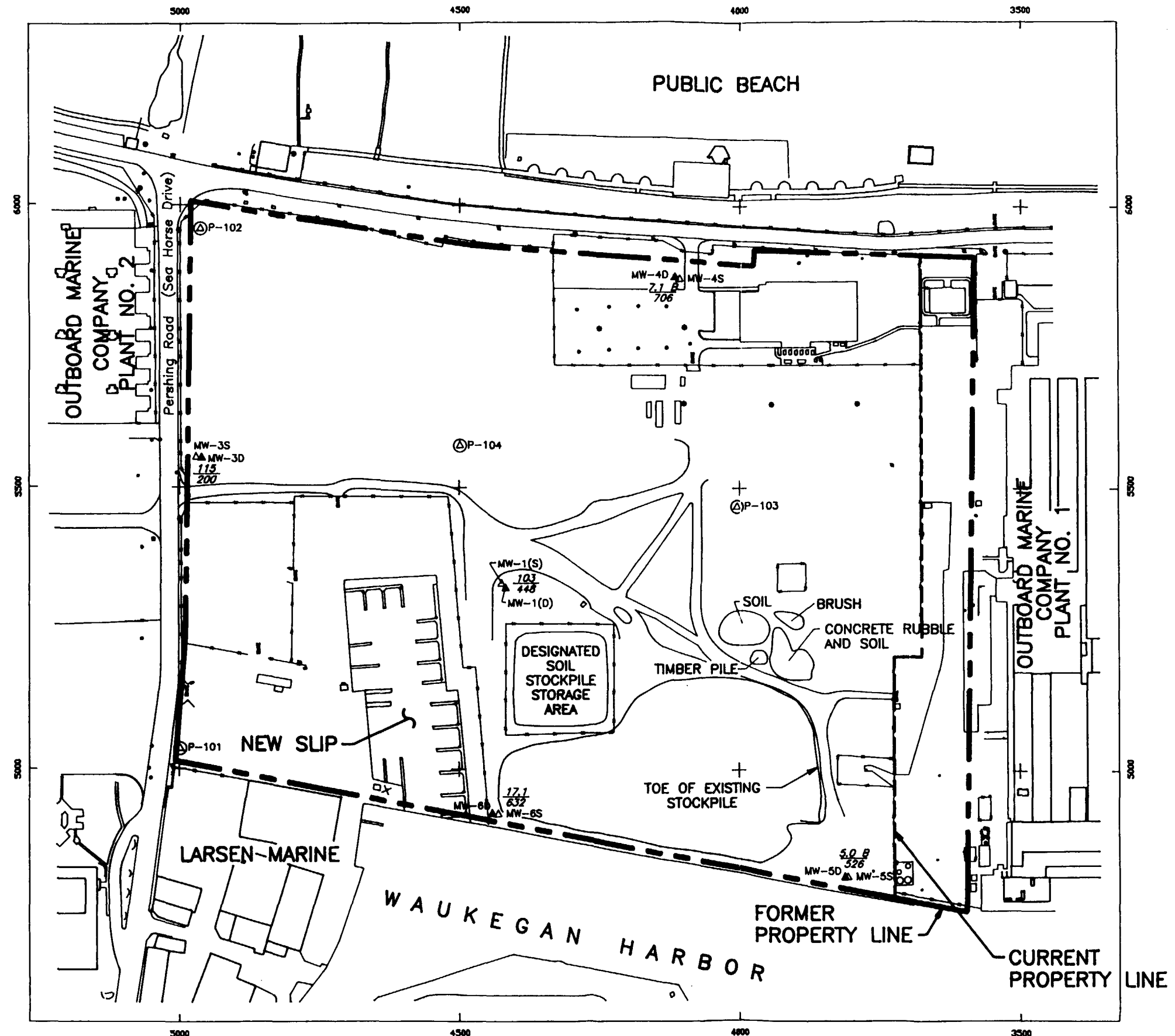
Figure 2.4-6
PHENOL
CONCENTRATIONS - GROUNDWATER
(Concentrations in ppb)



0 200
SCALE IN FEET

- - Utility Pole
- ⊙ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ▲ - Deep Monitoring Well
- ⊙ - Piezometer
- $\frac{270}{2200}$ - Concentration in the sample from the shallow well
Concentration in the sample from the deep well
- ND - None Detected

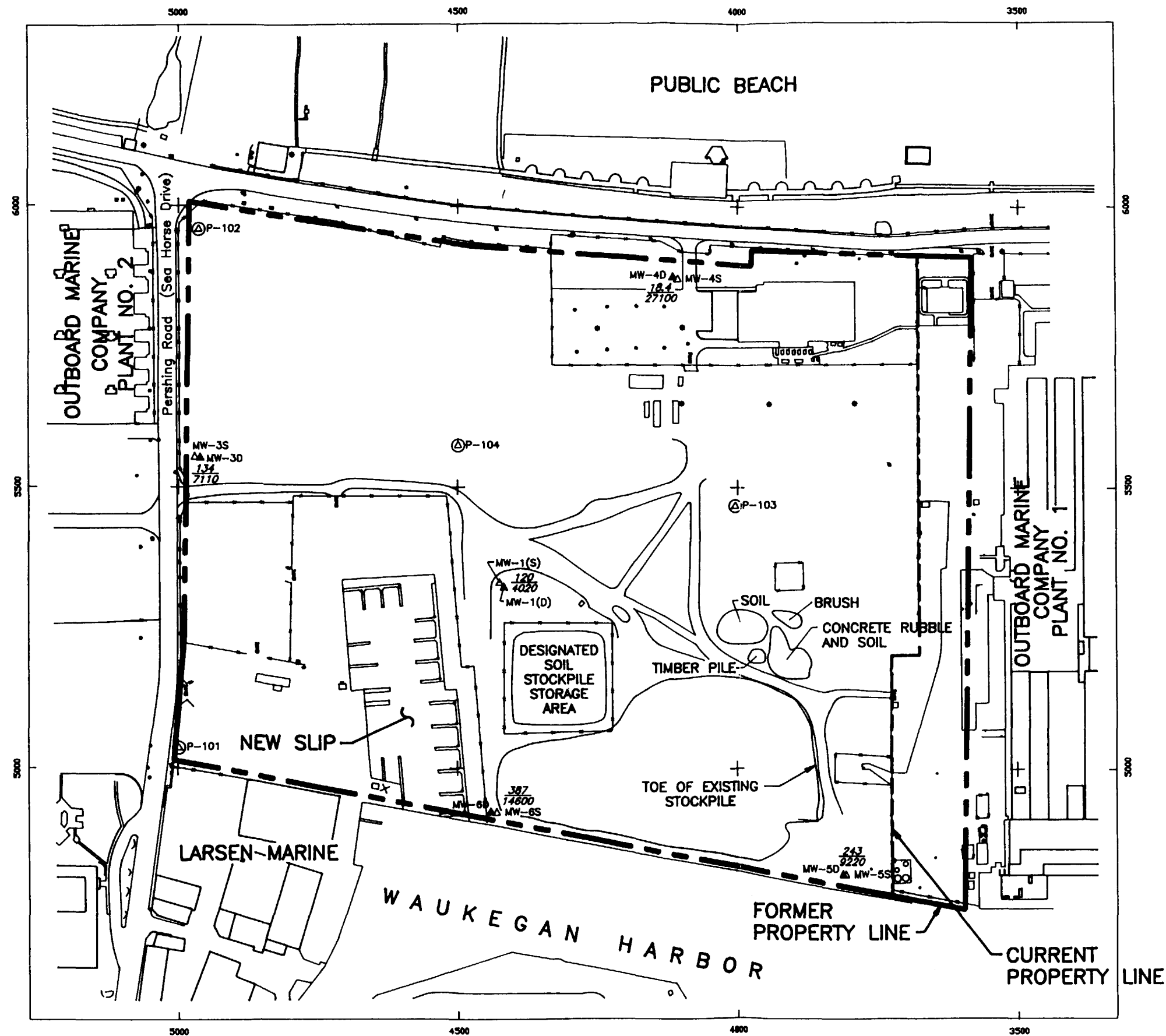
Figure 2.4-7
TOTAL BENZENE, TOLUENE,
ETHYL BENZENE, AND XYLENES
CONCENTRATIONS - GROUNDWATER
(Concentrations in ppb)



- - Utility Pole
- ✱ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- △ - Water Table Monitoring Well
- ▲ - Deep Monitoring Well
- ⊙ - Piezometer
- 115/200 - Concentration in the sample from the shallow well
Concentration in the sample from the deep well
- B - The Concentration is less than the Contract Reporting Detection Limit but greater than the Instrument Detection Limit

Figure 2.4-8
CYANIDE CONCENTRATIONS - GROUNDWATER
(Concentrations in ppb)

NAV 14-72511 200,000 08/30/1992 142712



- - Utility Pole
 - ⊙ - Light Pole
 - ◇ - Fire Hydrant
 - ◇ - Traffic Signal
 - - Post or Object
 - △ - Water Table Monitoring Well
 - ▲ - Deep Monitoring Well
 - ⊙ - Piezometer
- 120
4020
 Concentration in the sample from the shallow well
 Concentration in the sample from the deep well

Figure 2.4-9
ARSENIC CONCENTRATIONS - GROUNDWATER
(Concentrations in ppb)

NAF 16-72412 200,000 08/20/1982 1428113

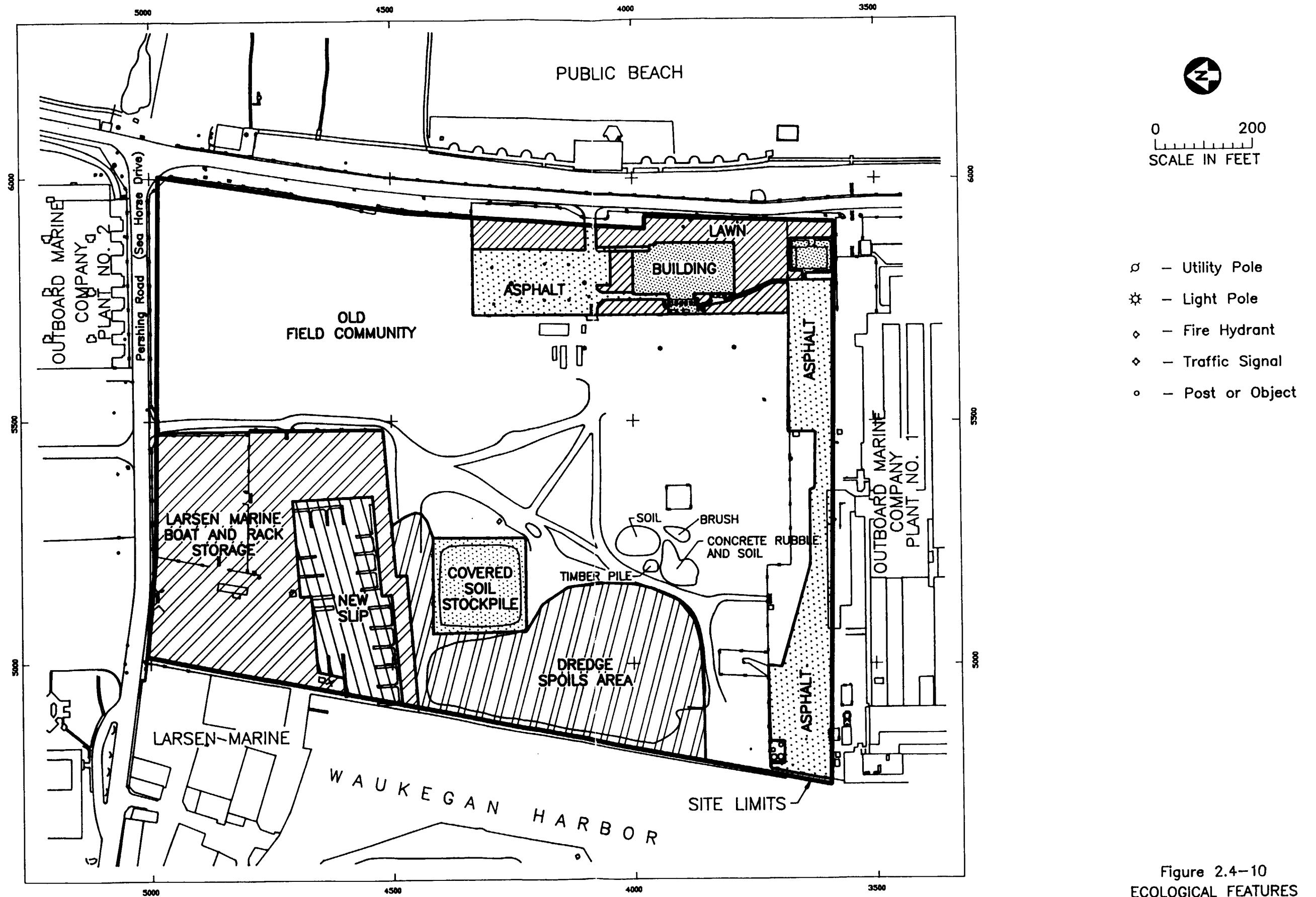


Figure 2.4-10
ECOLOGICAL FEATURES

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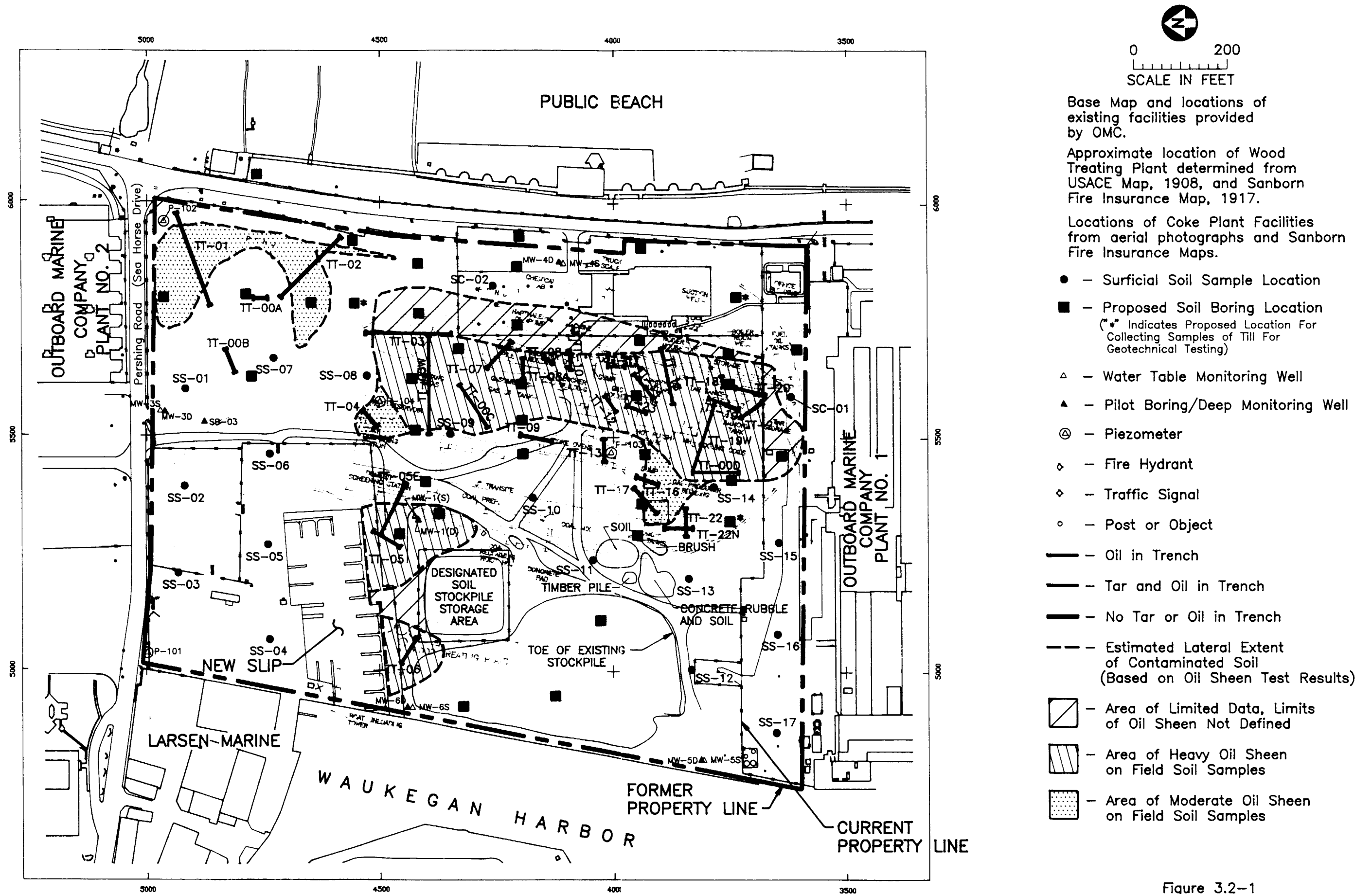
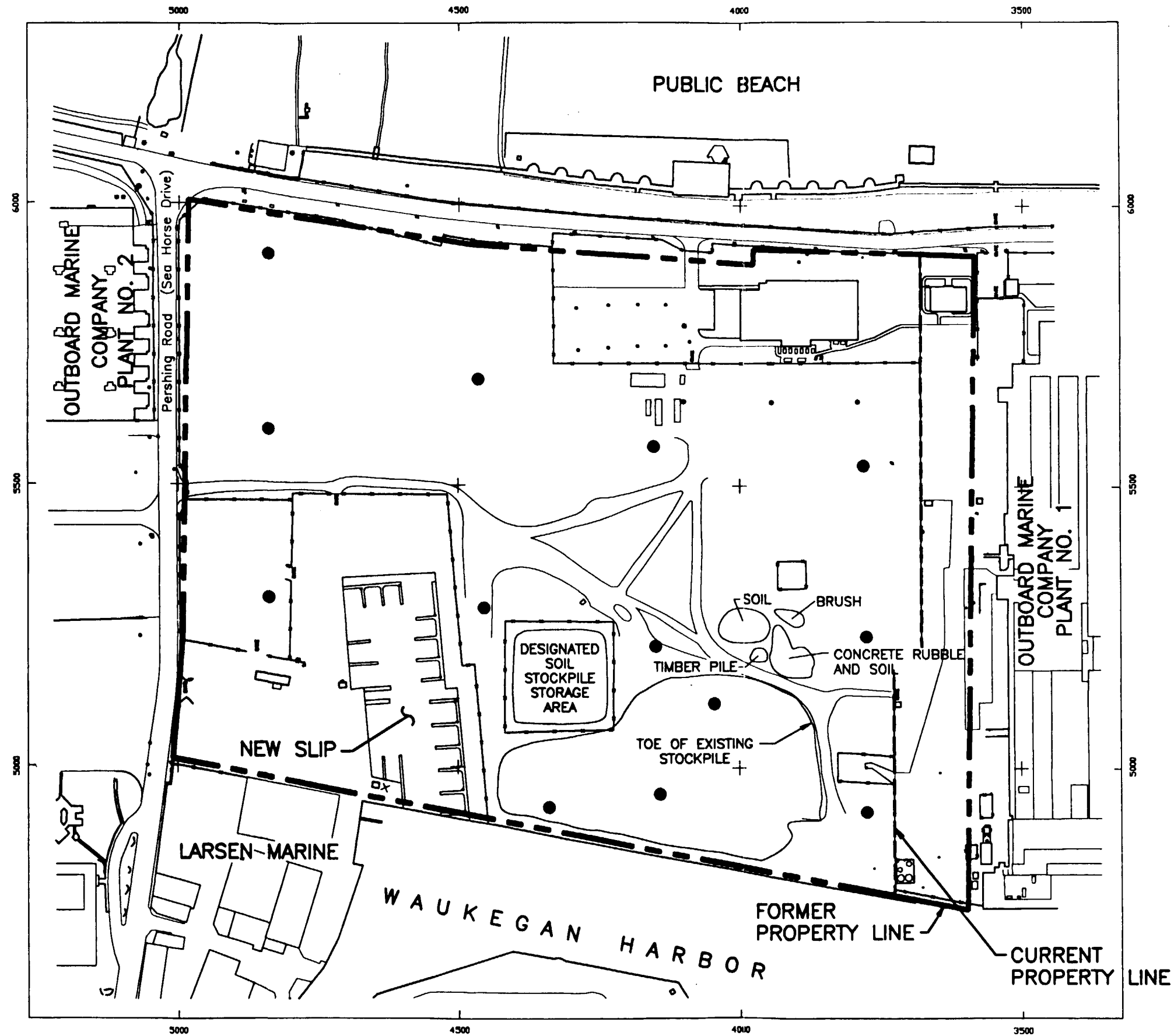


Figure 3.2-1
PROPOSED SOIL BORING LOCATIONS



0 200
SCALE IN FEET

- ⊕ - Utility Pole
- ⊛ - Light Pole
- ◇ - Fire Hydrant
- ◇ - Traffic Signal
- - Post or Object
- - Proposed Ground Surface Soil Sample Location

Figure 3.2-2
PROPOSED GROUND SURFACE
SOIL SAMPLE LOCATIONS

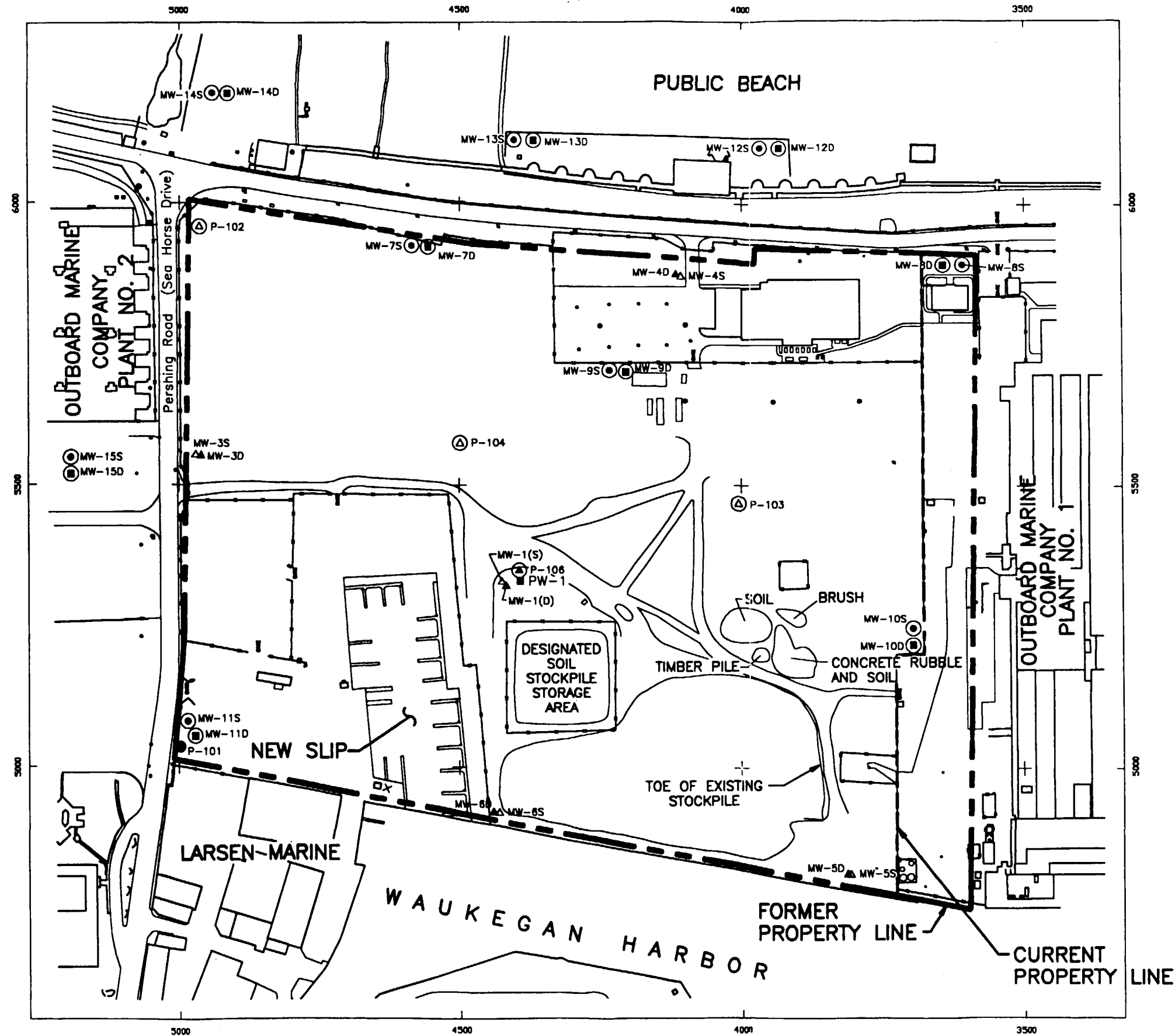


Figure 3.3-1
PROPOSED MONITORING WELL AND
PIEZOMETER LOCATIONS

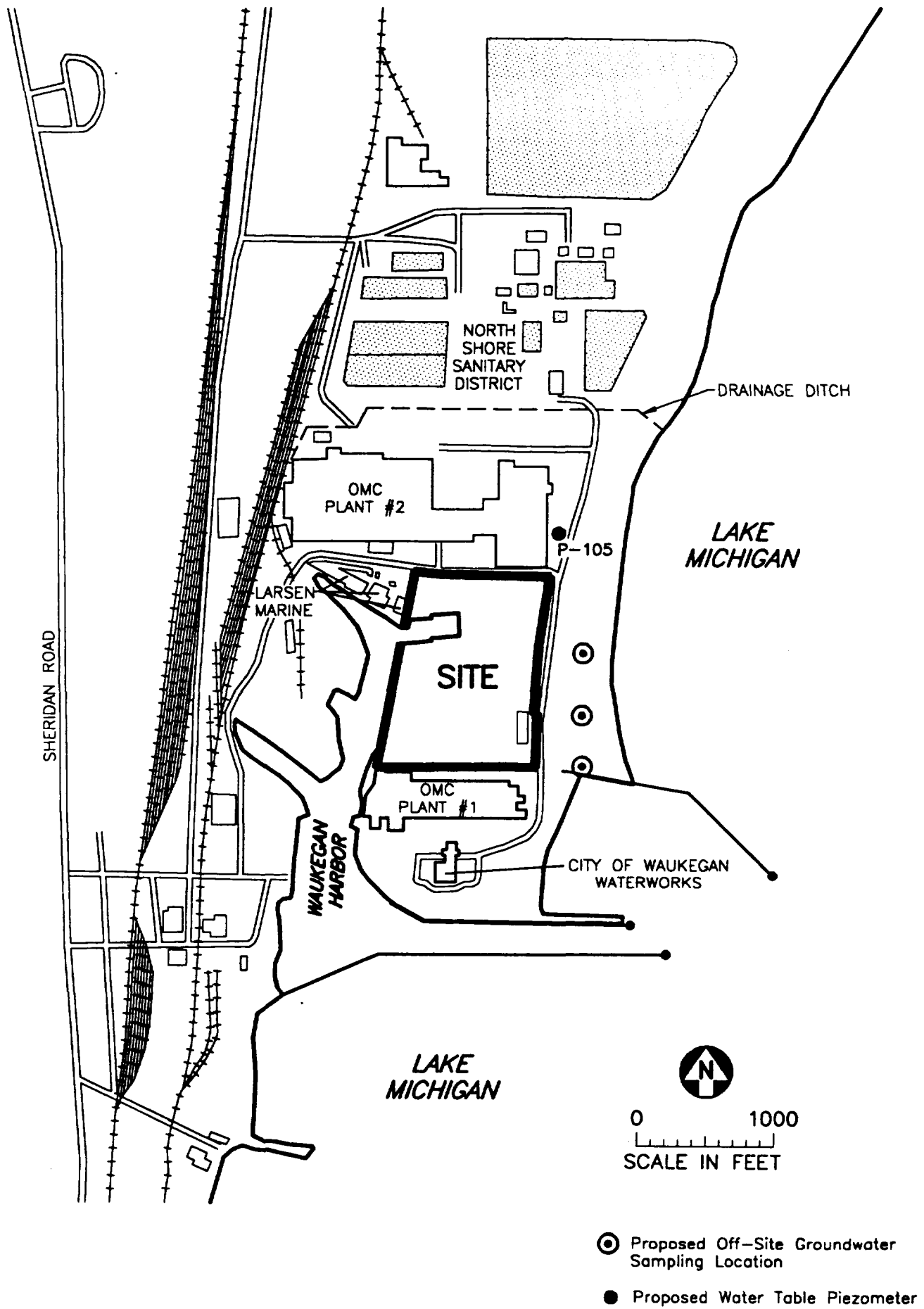


Figure 3.3-2
PROPOSED OFF-SITE GROUNDWATER
SAMPLE AND PIEZOMETER LOCATIONS

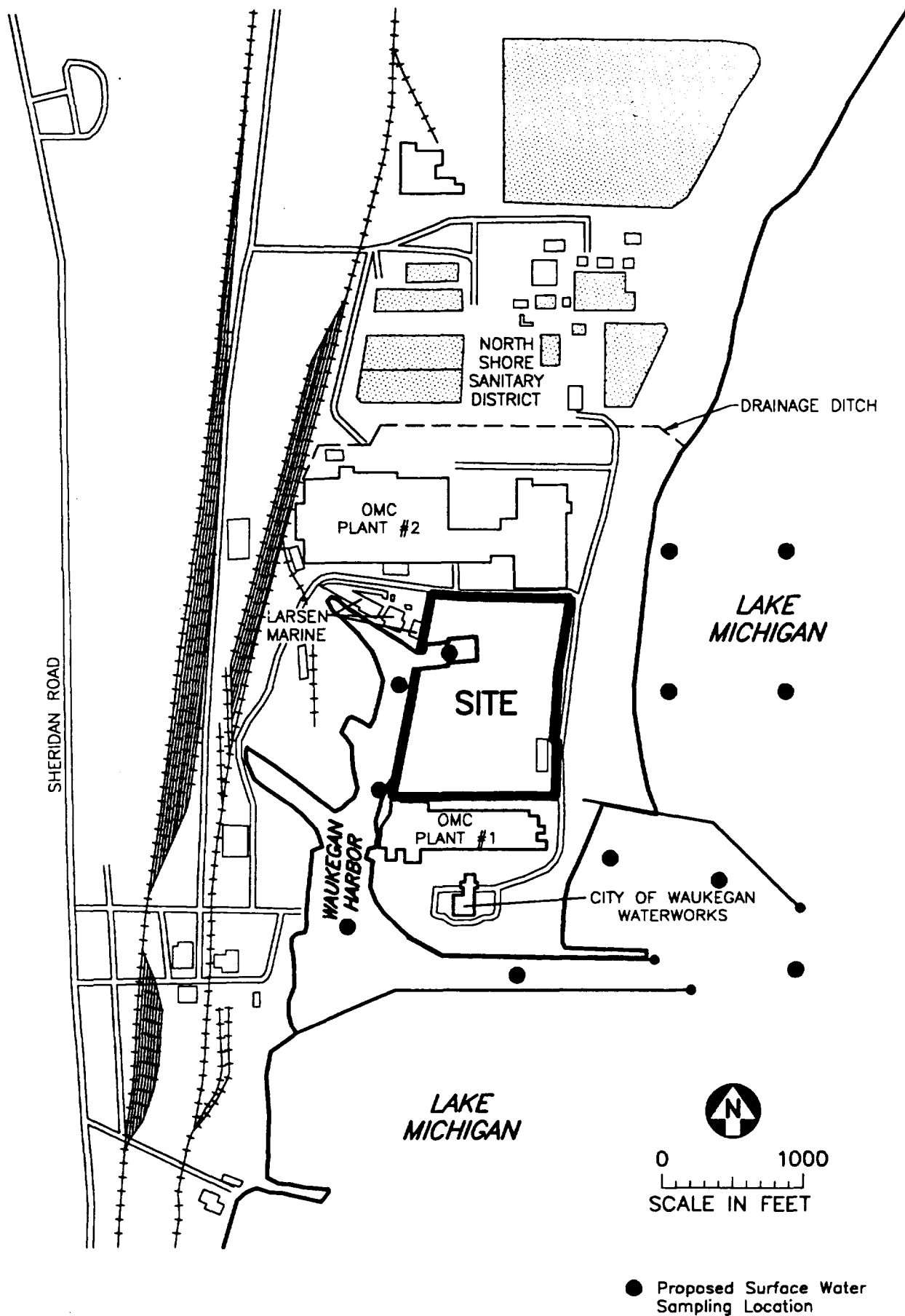


Figure 3.4-1
PROPOSED SURFACE WATER
SAMPLING LOCATIONS